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THE

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WATER-TUBE BOILERS IN THE NAVY.

"AN Admiralty 'memorandum respecting water-tube boilers in H.M. ships' was issued on Saturday as a Parliamentary paper in accordance with a promise made to the House of Commons, in order that members may have some official information on the performance of this much criticised form of steam generator in the forthcoming debate on Vote 8.

"The memorandum 'only deals with Belleville boilers or with boilers of large tube types,' the small tube description of boiler being dismissed in a few words, in the course of which it is stated that the experience gained with them 'does not, in the opinion of the Admiralty, justify their use in larger ships, although they have been adopted for this purpose in France and some other foreign navies.' The advantage of keeping to one description of boiler is insisted upon 'as the whole service becomes quicker accustomed to its use; artificers, both in the ships and dockyards, become more expert in its repairs, and there is to a large extent interchangeability of the spare parts and accessories.'"

Such is the account that appears in a daily paper, and we give it as an example of the way the public may be misled in this important matter, because it appears to us there is a general idea abroad that there are simply two classes of water-tube boiler, namely, the large tube, and the small tube, the latter not being considered suitable for big ships. Of course this begs the whole question. The small tube class if well designed will probably be found suitable for large ships. Of this we need here say nothing. What concerns us is the persistent confusion by the Admiralty of all large tube boilers under one heading. An attempt is made to defend the policy of the Admiralty on the ground that further experience will enable the initial defects of the Belleville boiler to be overcome, and it begins to look as though the Admiralty were endeavouring to cover their errors by gradually dropping the Belleville type and finally emerging with a different boiler altogether, which, being still a water-tube boiler, will be held up as justifying their policy. Now, we again state with emphasis that the Belleville boiler is not our idea of what a water-tube boiler should be. Its arrangement of tubes is, we think, a mistaken one, for the tubes appear to us to be wrong in inclination, wrong in connection, and wrong in length, and even if any two of the above faults were eliminated, the remaining one is sufficiently grave. It cannot be taken as a pattern of water-tube boiler that can be improved, and we should very much like to know through what influence or advice it was that our Navy has been endangered by such a choice.

The number of ships fitted with it is very large. There is a list of them at the Belleville stand at the Paris Exhibition. The British Navy occupies about a third, probably, of the whole list, and is painful reading. The *Highflyer* and the *Minerva* are specially named by the Admiralty, because the *Highflyer* having Belleville boilers, has been enabled to carry 6-inch guns in place of the

4·7 guns of the *Minerva*, whose boilers are 100 tons heavier. Granting the 100 tons for a moment, this argument is about on a par with the halving of a locomotive fire-box, so that the cylinders may be made bigger. But if we are to believe Messrs. Durston and Oram, the saving in weight is a myth; and the *Highflyer* used so very much more coal, even with a special inspector of machinery to help the men, that even the 100 tons, if genuine, must have been wiped out of account in an ordinary voyage.

Much is made of the use of water-tube boilers in foreign navies, and other names than Belleville are cited—the Niclausse, D'Allest, Babcock & Wilcox, Yarrow, and others. We are glad to see the Admiralty have become aware of the existence of other boilers of the water-tube type, but it seems clear they are hiding the Belleville matter under a cloud of dust-throwing, for all this talk about the water-tube principle is so much dust-throwing. We, ourselves, have not raised special objection to the principle. Our chief contention has been against the selection of so palpably erroneous a type as the Belleville, to the practical exclusion of all others.

Mr. Goschen made a long statement in the House on July 17th, but it appears to be very shallow, and somewhat flippant, and it had the disadvantage of being seemingly a statement got up by some technical man for a Minister who could give the statement, but could not answer questions on it. His talk about the failure of the *Europa* was simple moonshine. She is, he told us, sister to the *Niobe*, which "has done so well," but the fault in the *Europa* cannot be found. Truly strange, and, if true, only a most powerful argument against a boiler which fails in one ship and succeeds in a sister ship through some detail defects that cannot be found. Mr. Goschen is smart. He rings the changes for the water-tube boiler from France to the United States. Now the U.S. Navy has, we believe, no Bellevilles; it has the Ward boiler experimentally. But Mr. Goschen knows the general public, and thus confuses the issue. He mixes up the Belleville so skilfully with the whole water-tube question, that when some day a more common-sense water-tube boiler has been installed with some fair success, he will be able to triumph. However, it should be seen to that such a retreat is not allowed. We want explanations for the extravagant and unnecessary first experiment of the *Terrible* and *Powerful*, and the policy of continuing that experiment in the Navy at large when the Belleville failure in the first vessels was so pronounced. Mr. Goschen, with regard to the testimony from the United States, remarked that the following is what the Chief Engineer of the United States says on the subject :—

"The fact that the water-tube boilers raise steam quickly is of the greatest advantage. I have stated elsewhere that I consider the battle of Santiago to have developed the necessity of the use of water-tube boilers, whether it taught us anything else or not."

That is pretty strong. And again :—

"It would have been the greatest advantage to have had during the blockade of Santiago boilers capable of raising steam in less than half an hour."

In another passage he says :—

"In the meantime, all that I can have to say is that the use of water-tube boilers has been definitely decided for our naval vessels, because water-tube boilers give tactical advantages of great moment, and because with care in the selection, manufacture, and management of water-tube boilers, their disadvantages may be neutralised."

This is precisely our position. I do not disguise the disadvantages, but we believe they can be neutralised, and will gradually be neutralised.

Now is not this very pitiable when we all know that the U.S. Navy has no Bellevilles? Mr. Gibson Bowles called attention to the small number of Belleville boilers in the navies of the countries used by Mr. Goschen in championing the Belleville cause. Even France has practically discarded the Belleville. Her authorities, he states, believe it to be bad in principle, difficult to work, and a "box of tricks."

Mr. Allan, of Sunderland, demolished Mr. Goschen's statements. He exposed the fallacy of the claims made, and pointed out that the *Powerful* had required 10 days to run 1,500 miles; she had never done 22 knots yet. Her list of defects was so great, that the Admiralty would not publish it. The *Terrible*, at a time of national emergency, only did 15 knots. The *Europa* ran from Suez to Colombo at 7½ knots. The Belleville boiler had 48,000 joints. The *Pegasus* was ordered home in 15 months, and had not done two months of work. The water-tube boiler gave no gain in weight. Other members traversed the statements of Mr. Goschen, and reduced them to pulp.

Let members keep the subject alive. We believe the country has been misled in the matter of the Belleville boiler, and that the excuses now made are vain and empty delusions. The more that is published, the greater the explanations put forward, the worse does the whole affair appear. The sooner a change is made the better. There can hardly be too much hurry. Even if we hold to water-tubes, there are better boilers than the Belleville to be found.

Relation of Generator to Motor Capacity in Electrically-driven Workshops.—At the Baldwin Locomotive works an installation of 700 H.P. of generator capacity was erected, for the operation of motors throughout the works whose aggregate capacity amounted to about 2,000 H.P. The generator capacity was at first sufficient, as the load at the switchboard did not exceed 570 H.P. The increase in the number of motors installed, however, has called for an increase in the generating capacity. The present generating capacity is 1,550 H.P., and the aggregate motor horse-power is 3,500. Of the generator capacity, however, one unit of 250 H.P. is in reserve, leaving 1,300 H.P. in use. Of the motors installed an average of about 400 H.P. is idle or under repair, thus the proportion of generator to motor capacity is 1,300 to 3,100, or 42 per cent. Many of the motors are of greater capacity than the work for which they are designed, in order to enable the motors to cope with any extraordinary demand in regard to load. In large works, where the number of motors is considerable, about 33 per cent. ratio of generator to total motor capacity should in general be sufficient, but in small works, or in cases where the number of motors is small, and the work they have to do calls for large power, the determination of the proportion of generator to motor capacity must be arrived at by a careful consideration of the local conditions.

Underground Pipes.—In connection with the question of the durability of underground systems of telegraph or electric light, it may be mentioned that experience has shown that whilst pipes of steel or wrought-iron rapidly deteriorate, this is not the case with pipes of cast-iron. A good firm coating of Angus Smith's composition for any class of iron pipes is a good preservative, but is not infallible, as it cannot be prevented from being chipped off under rough handling.

SOME INTERESTING FAULTS ON TELEPHONE CIRCUITS.

By "BUSYBACK."

The presence of electric light mains near telephone circuits frequently causes disturbances in the latter, even though there is no actual contact or leakage between the two circuits.

On one of my visits to a certain small telephone exchange I was surprised to hear a most extraordinary noise on all the telephone lines. By listening on several of the lines which were run in different directions, the neighbourhood of the disturbing cause was located by the increased loudness of the sound. On going to the place indicated, a man was seen drawing over the ground a peculiarly constructed piece of apparatus supported on wheels heavily insulated with rubber tyres. Closely following this apparatus was another man carrying and listening at a telephone receiver in connection with the apparatus on wheels. At the central station there was a large induction coil sending a high potential alternating current into the cable. The whole of the proceedings were, of course, to locate the position of a fault in the electric light cable.

What struck me at the time as being remarkable was the fact that although the sound was loudest on lines which earthed near the fault in the light main, yet on lines which

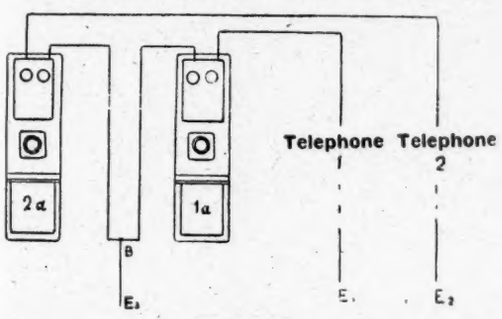


Fig. 1.

were earthed three or four miles on the opposite side of the exchange to the fault, there was sufficient noise to render conversation very difficult; on the lines which earthed near the fault the noise was so loud as to entirely prevent conversation.

Defective or unsuitable material will often cause a great deal of trouble; several instances could be quoted, but one must suffice.

On a certain telephone circuit difficulty was frequently experienced in calling the distant end and in conversing after attention had been obtained. Frequent tests did not reveal this difficulty for some time, as sufficient allowance was not made for a partial earth which was on the line at the time. The fault was eventually located in some underground wire; on this wire being taken up and examined, it was found that the copper had been reduced to a fine powder in several places, caused, no doubt, by some impurity in the ozokerite insulation. The effect of the wire being so reduced to powder was to increase the resistance of the line to such an extent as to shunt so much current to earth through the faulty insulation that sufficient did not reach the distant end to ring the bell.

On single line systems of telephones, faulty earth wires frequently cause overhearing and partial contact. The reason for this will be apparent if fig. 1 is referred to.

When two or more telephones complete their circuit through one earth wire and any resistance is introduced in it, instead of all the current going to earth at E, a portion of it, depending on the resistance of the earth and of the instruments, will continue along the wire to the second telephone, and through it to earth again at the far end of line 2. If the resistance of the earth is sufficiently high all the bells will ring when one is rung; if it is not high enough only one bell will ring, but speaking will be overheard by any one listening on the other circuit.

A resistance in the earth wire may be caused by the wire being badly soldered to the earth plate or to the water pipe, thus allowing corrosion to set in between the pipe and the wire, or it may be due to the wire being broken at some point and a loose joint being made, which soon becomes of high resistance through the oxidation of the wire. In one case two telephones were put into intermittent contact by an ordinary bellhanger's joint being made in the earth wire, evidently by some person who had broken it and joined the pieces together thinking them to belong to an ordinary bell.

If the water pipe to which the earth wire is soldered is fed from a cistern there will frequently be sufficient resistance

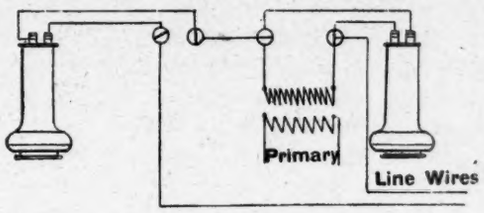


Fig. 2.

introduced to cause difficulty, especially when the cistern is empty or the water is low, through there being no direct metallic connection between the main supply pipe and the pipe from the cistern.

Faulty connecting up of the various parts of an instrument will frequently give rise to peculiar faults. In one case which has come under my notice, a second receiver was connected to an instrument, and there not being any special terminals on the instrument for this purpose, the receiver was connected in shunt with the induction coil secondary instead of in shunt with the first receiver. The effect of this was that messages could be received all right, but could only be transmitted very faintly, because the current which should have gone to line shunted through the second receiver. (See

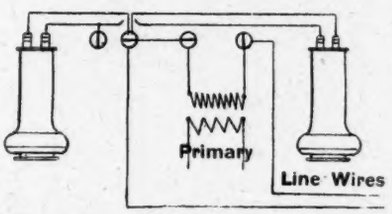


Fig. 3.

fig. 2.) The longer the line the greater would be the proportion of the current circulating through the second receiver, and the smaller the quantity which would reach the instrument at the distant end of the line. The connections should have been as in fig. 3.

An interesting fault, which caused considerable trouble, was the following:—Complaint was made of there being a current on a certain telephone line when the instrument was

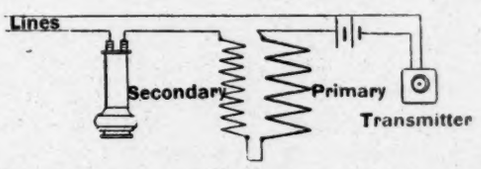


Fig. 4.

in use. Several fruitless efforts to find the cause of this trouble were made, till on one occasion it was found that disconnecting the primary circuit also disconnected the secondary circuit. Careful examination showed that the primary and secondary circuits were connected in series as in fig. 4, and not as they should have been as in fig. 5. The effects of this careless connecting up were rather curious. While speaking, the current was sometimes strong enough to actuate the ring-off signal, and thus cause the attendant to

disconnect the circuits when they should have been left connected. The speaking properties of the telephone were not interfered with to any appreciable extent; at any rate, no alterations of the speaking powers of the instrument were noticed on a short line.

Late one evening I was summoned to a certain fire station where there were a number of bells in the various firemen's rooms. These bells were all in parallel, and fed from one source of current. On my arrival at the station none of the bells would ring; as the source of current was in order, all the lines to the various bells were disconnected in turn, till at last the faulty circuit was disconnected, when the whole of the bells, with the exception of the one on the faulty circuit, rang. It being late, the faulty circuit was left disconnected with the remainder of the bells ringing as usual. Early the following morning the faulty circuit was tested and found to be in order, and the bell rang all

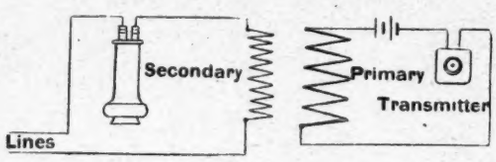


Fig. 5.

right; also on connecting it to the main circuit, it, and all the other bells, rang as usual. On a thorough examination of the circuit which had caused all the trouble it was found that the fireman who inhabited the room in which this bell was fixed had been putting up some new window blind fittings; these had chafed through the insulation of the wires where they were brought through the window frame, and caused them to be short-circuited when the window blind was drawn down; thus the whole of the current passed through the short-circuit caused by the blind being drawn at night; consequently none of the bells rang. On the blind being drawn up in the morning, the short-circuit was removed, and the bells rang as usual.

A very annoying fault is frequently caused by wires breaking under their coverings. This class of fault is so apt to be intermittent, and everything to be in apparently good working order while being examined. In testing for such faults a low battery power should be employed, not more than two or three cells, as a higher electromotive force is liable to break the fault down and leave the circuit good until it is disturbed.

From the few examples given, it will be seen that telephone circuits are subject to many causes of interruption, especially as only the more interesting or more uncommon causes of interruption have been mentioned.

ON THE PHOTOMETRY OF ARC LAMPS.

By F. W. CARTER, M.A., Cantab.

(*Continued from page* 121.)

The addition of the mesh diagram to a photometer vastly increases its value for the work in hand, but there is still a source of indefiniteness left, due to our definition of equal illuminations not necessarily fulfilling the condition of being additive. In fact, if two illuminations are equal according to our definition, and they be both doubled, they *may* no longer be quite equal. I say "may" because I am by no means sure that the trouble really exists, though one would expect it to exist, and would naturally assume its existence in the absence of knowledge to the contrary, since different coloured lights produce different sensations, and it is unlikely that doubling the lights would increase the sensations in the same proportion. The phenomenon in question is not that of Purkinje*, wherein an estimate of the intensity of illumination is made without the aid of a mesh diagram, and so not in accordance with our definition. However, the indefiniteness is removed by always reducing the apparent brightness of the diagram to the same value for the purpose of observation, which is possible in the improved form in which the photometer is being put on the market. This is shown in side and front elevations in fig. 5, which shows the telescope through

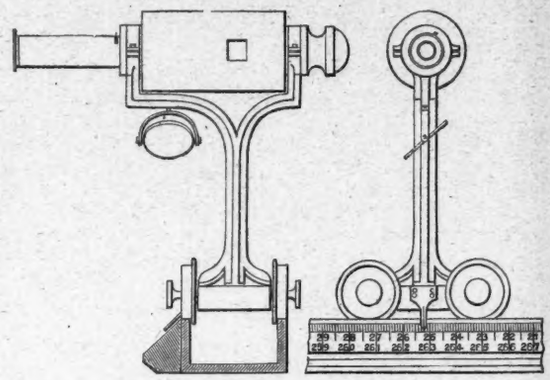


Fig. 5.

which the mesh is seen, whose aperture can be altered by means of an adjustable diaphragm in order to vary the apparent brightness of the mesh. The use of a telescope is a considerable aid to good observation since it overcomes any error due to differences in the two eyes of an observer, and allows him to easily concentrate his attention on the diagram, besides forming an image of definite angular dimensions—an important provision when a mesh diagram is used. The design used in the diagram is shown in fig. 6, and the size is such that a normal eye at a distance of 10 inches can just distinguish the centre squares, when the brightness is that of a white surface having an illumination of a candle-foot. This is taken as a convenient amount to

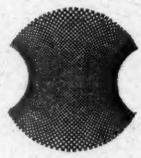


Fig. 6.

which to reduce the brightness for this work. The photometer head can be reversed in order to test the equality of the two sides, and, if a difference is found, it can be rectified by simply turning a screw. The line of squares equal to those at the centre of the diagram forms a portion of a lemniscate or figure eight (∞), and the observer adjusts the position of the photometer and aperture of the telescope until the two indistinct portions just meet at the centre. His candle-power is then independent of the length of the bench on which it is obtained.

Light which strikes even a black surface at grazing incidence, will be largely reflected regularly, and may affect the photometer; and such light should be cut off by screens at right angles to the surface. Thus a few movable screens are often required to cut off the light reflected from the top of the photometer bench.

So much then for the room and its appointments. The general method of making a test will be sufficiently understood from the foregoing, but a few practical hints conducive to good working, may be usefully given here. Two operators at least are required to carry out a test, one to take the readings—who should not allow himself to see the arc, at any rate without dark glasses on—and the other to put the lamp in position, and to see that it is burning under normal conditions; the latter may also see that the standard keeps constant. If a gas standard be used, it should be lit a quarter of an hour before the tests begin, as it will probably vary in warming up. The same remark applies to the primary standard. It is well to calibrate the secondary

*See Palaz's "Treatise on Photometry," page 78 (English translation).

standard before and after the tests each day. If the arc, during some period, is found to be varying rapidly—as is often the case just before feeding—the readings should be discontinued until it is approximately steady. Several independent observations should be made in each position of the lamp, and the mean reading taken to give the candle power. The common practice of discarding a reading simply because it differs considerably from others of the same batch, cannot be too strongly condemned. The calculations can be made with ease and rapidity by means of a slide rule.

The candle-power is—

$$\text{I} = \left(\frac{\text{distance of arc from photometer}}{\text{distance of standard from photometer}}\right)^2 \times$$

$$\text{(candle-power of standard)} = \left(\frac{a}{b}\right)^2 \text{s, say.}$$

Clearly then, with a slide rule of the Gravet pattern, if on the lower scale we put b, on the slider, opposite a, on the rule, and on the upper scale look, on the rule, opposite s, on the slider, we shall obtain I, so that the one adjustment is sufficient to obtain the result required. If, however, we construct once for all a curve having $(a/b)^2$ as ordinate, and a or b as abscissa, we may reduce the calculations to the multiplication of the ordinate corresponding to the reading by s.

When a test has been made, a polar curve should be drawn, having the radius vector in any direction equal to the candle-power of the arc in that direction, angles being measured from the axis of the lamp. Some uses of this polar curve were given in a recent article by the present writer.*

Perhaps the fairest way of stating the power of an ordinary commercial arc lamp—in so far as it can be done by a single number—is by giving the mean hemispherical candle-power over the lower hemisphere, when the lamp is to be used for public lighting, and by giving the mean spherical candle-power when it is for shop or indoor lighting. These are easily calculated from the candle-powers in different directions—preferably taken from the polar curve—in the manner indicated in the following :—

θ (measured from axis)	I	I sin θ
0	I_0	0
10	I_{10}	I_{10} sin 10°
20	I_{20}	I_{20} sin 20°
— — — — — — — — —	— — —	— — —
90	I_{90}	I_{90}
		Σ (I sin θ)

The mean hemispherical candle-power, H, is—

$$\text{H} = \{\overset{90}{\underset{0}{\Sigma}} (\text{I} \sin \theta) - \tfrac{1}{2} \text{I}_{90}\} \times 0{\cdot}174 ;$$

that is, H is 0·174† times the sum of the values of I sin θ for every 10° between the axis of the lamp and the horizontal, diminished by a half of the horizontal candle-power. The mean spherical candle-power is $0{\cdot}087 \overset{180}{\underset{0}{\Sigma}} (\text{I} \sin \theta)$, or 0·087 times the sum of the values of I sin θ for every 10° between the downward and upward vertical.

(To be concluded.)

THE INCANDESCENT LAMP.

By ED. C. De SEGUNDO, Assoc.M.Inst.C.E.

(*Concluded from page* 120.)

A common standard of candle-power has now been adopted among American manufacturers, namely, the English Parliamentary standard taking the mean horizontal candle-power of each lamp when rotated at about 180 revolutions per minute, and it is stated by Mr. Willcox that the leading makers now photometer each and every lamp, with the result that lamps at the present day supplied by reliable manufacturers may be considered to be tested to a quarter of a volt, no lamp varying more than one candle above or below its rated candle-power, nor more than 6 per cent. above or below its rated wattage. Such a condition of things is in the highest degree desirable since the average efficiency of the lamp is thereby increased, which means that it will grow in favour with the users of electric light. Mr. Willcox does not state specifically that the above eminently satisfactory methods of dealing with lamps apply to 200-volt lamps, and from the general context it would appear that 100-volt lamps are referred to. It is to be inferred that practically the same difficulties are experienced in America that have been met with here in turning out a thoroughly satisfactory 200-volt lamp, and at first sight the reason seems somewhat obscure, at least so far as 16-c.p. 200-volt two-filament lamps are concerned.

In Europe the 8-c.p. lamp is used to a much greater extent than in America, where the 16-c.p. lamp is taken as the standard of lighting. Of course every one knows that a 16-c.p. lamp is more easily turned out than an 8-c.p., and comparisons of the behaviour of incandescent lamps in Europe and in America would hardly be fair if, as is probable, the proportion of 16-c.p. lamps is higher in America than it is here. The demand for 8-c.p. lamps, however, is growing very rapidly in America, and for very obvious reasons, so that manufacturers must turn their attention to 8-c.p. lamps, for which in all probability there will be a larger demand in the future, proportionately, than there has been in the past. But

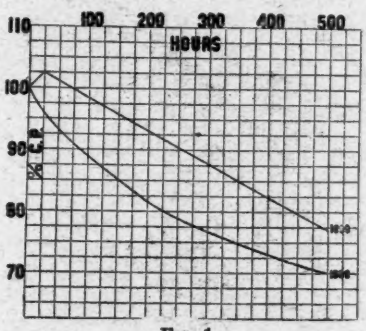


Fig. 1.

it is reasonable to assume that any improved methods will apply as well to the manufacture of 16-c.p. as of 8-c.p., and hence the 8-c.p. will probably always lag behind the 16-c.p. in efficiency for equal life.

Mr. Willcox gives a diagram, fig. 1, showing 10 years' improvement in candle-power performance of 3·1-watt lamps in America. It is interesting to note the upward tendency of the candle-power during the first few hours of life in the 1899 lamps, and that 1888 lamps sink to 80 per cent. of their original candle-power in 200 hours, whereas 1899 live 450 hours before this diminution in candle-power is reached.

The fact that an incandescent lamp must diminish in candle-power per watt as time goes on is only just beginning to be fully realised. Hitherto a 16-c.p. lamp has been spoken of as such at all periods in its life because the number 16 appeared upon it when sold. It may have given 20 c.p. or 12 c.p. initially, and may have dropped very rapidly in luminosity during the first few hours of its life, but to its purchaser it always remains a 16-c.p. lamp. The same superstition seems to cling to incandescent lamps in America, and Mr. Willcox suggests that much of the blame for this is to be laid at the door of gas. It is only natural, after all, that the conditions under which light was produced by the well-known method should tend to obtain when dealing with the new method. Gas burners were bought and renewed by the consumer, therefore electric light burners were to be dealt with in the same way. The gas burner was usually only renewed when it was broken ; therefore those who replaced their gas burners by electric lamps naturally burnt the filament to destruction, and then quite reasonably complained that the electric lamp at 4s. did not last one-tenth of the time that a 1d. gas burner could be relied upon to give light. In gas lighting, the light is primarily dependent upon the quality of the gas, a burner by a good manufacturer suffering little deterioration, except by fouling, but in

* See Electrical Review, December 22nd and 29th, 1899.

† *i.e.*, $\frac{10\,\pi}{180}$, the circular measure of the common interval 10°.

electric lighting the quality of the light depends upon the burner.

There is, therefore, much to be said for the principle adopted by not a few of the leading electric light companies in America, of supplying all the lamps required by the consumer on a free renewal basis. Of course, the lamps are indirectly charged for in the price of energy, but the consumer thinks that the lamps are thrown in, and this also

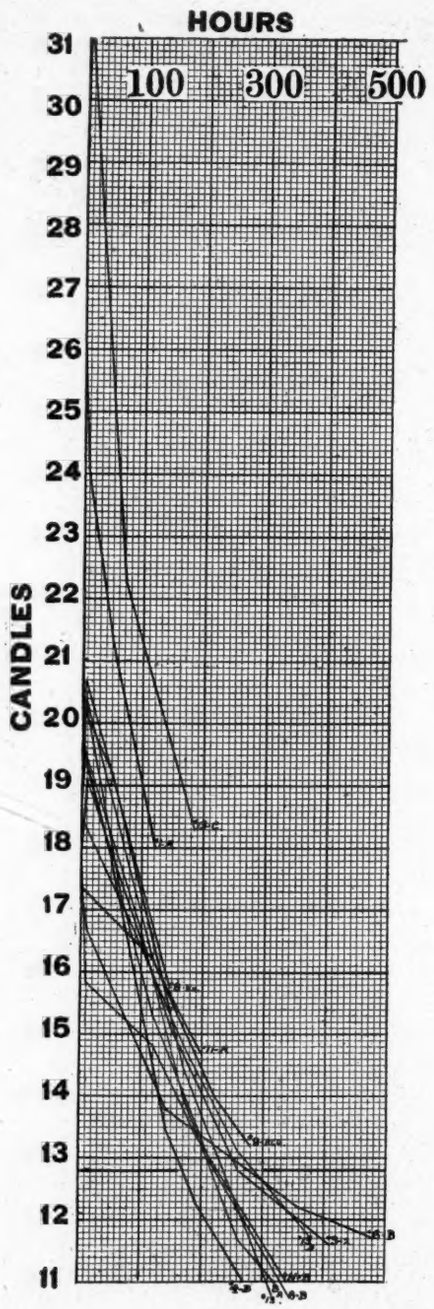


Fig. 2.

tends to popularise the electric light. This method, also, has the advantage that orders for lamps are placed with the manufacturers systematically, and they can make arrangements for the supply in advance, and thus run their works at a far more uniform rate, which reacts not only upon the cheapness, but also upon the quality of the lamp turned out.

Under the system in vogue in this country, the consumer rarely keeps a stock of lamps himself, and the retailer does not do so to any extent either, with the inevitable consequence that orders pour in to the manufacturers during the winter season, and almost cease during the summer months.

Another evil resulting from the fact that consumers provide their own lamps is that the consumer very naturally prefers that lamp which burns longest, and is cheapest. It is difficult for the consumer to appreciate the true loss of light, owing to the gradual diminution in general illumination in the room. In these circumstances electric light tends to remain dearer than gas, as, apart from the fact that such lamps as above described must of necessity be low-efficiency lamps, it very often happens that the consumer changes an 8-c.p. lamp for a 16-c.p., or a 16-c.p. for a 32-c.p., in order to get more light, thus incurring double the expense for energy, whereas by the introduction of a good $3\frac{1}{2}$-watt lamp, the desired illumination might quite possibly have been attained, and the cost, if anything, lowered even in comparison to the original lamp. It is, of course, impossible to expect the average consumer to go into the question of the proportion borne by the cost of the lamp to the cost of energy used during its life. But this is certainly a matter which the supply company can take into consideration to the ultimate advantage of themselves, the consumer, the manufacturer, and the electric lighting industry in general. Under existing conditions the position of the incandescent lamp is more that of a power user than that of a light producer. Lamps are sent out by manufacturers which no doubt may have been tested by a wattmeter, but which though correct as to wattage may be lamentably high as to watts per candle. The converse also holds, and the average of a whole consignment may even be fairly correct as regards initial or tested watts per candle; but the result in working is eminently unsatisfactory, as the low watts-per-candle lamps have a short if a merry life, and the high watts-per-candle lamps do not in any sense make up for their deficiencies. What is wanted is that each and every lamp should approach as nearly as possible to its description both as regards watts and candle-power.

Bearing upon this subject, fig. 2 is instructive. It is taken from Mr. Willcox's paper, and illustrates the very rapid

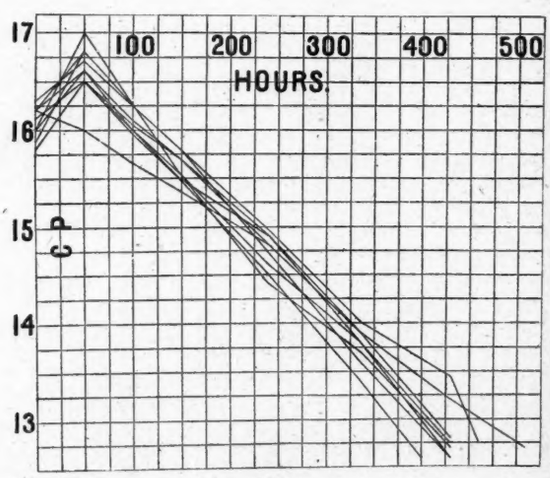


Fig. 3.

fall in candle-power of lamps which initially yield a candle-power much in excess of what they are intended for. The lamps from which this diagram has been prepared were supposed to be 16 c.p.

Fig. 3 shows the performance of 10 16-c.p. 112-volt 3·1-watt lamps. The lamps are well made and the results good.

Summing up, it would appear to be in the interests of all concerned that

1. The incandescent lamp should be considered by manufacturers first and foremost as a light giver.

2. Every effort should be made to raise the average efficiency.

3. Every lamp should be tested for candle-power as well as energy consumption before leaving the works.

4. The supply of lamps to consumers should be intelligently organised as this would benefit the consumer by giving him a more continuously good light for the same expenditure, and

would enable standing orders to be given to manufacturers, thus greatly facilitating the production of lamps on approved principles.

SOME NOTES ON THE ELECTROLYTIC DRILLING AND SLOTTING OF METALS.

By SHERARD COWPER-COLES.

Experiments were undertaken with the object of ascertaining whether it is possible to drill and slot holes electrolytically at a sufficiently rapid rate to be of commercial value. Such a process would have many advantages, as hard tempered plates, such as armour plates, could be drilled without withdrawing the temper, in position. The process, no doubt, would also be found very useful for submarine work, as plates, bolts, chains, &c., could be cut, using the salt water as the electrolyte, the only apparatus required being the drilling nozzle and a small wire for conveying the electric current. The apparatus could be placed in position by the diver, and would not require any further attention until the work was complete. Another feature of interest is that holes of any shape could be drilled, such as illustrated in fig. 1.

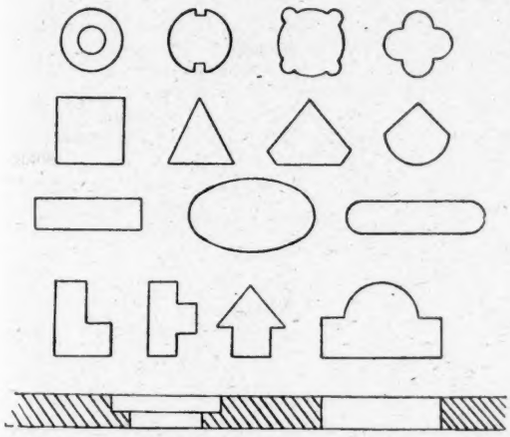


Fig. 1.—Shapes of Holes Drilled by the Cowper-Coles Electric Drilling Machine.

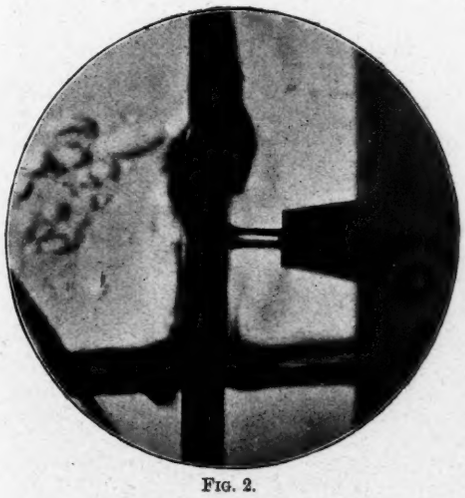


Fig. 2.

In the first experiments the electrolyte was projected on to the iron to be drilled, as shown in fig. 2, a strong current of electricity being caused to flow from the metal to be drilled through the jet of liquid and thus back to the source of electricity. This method was found to be fairly satisfactory, but the holes were not sufficiently true. A nozzle was then constructed, such as shown in fig. 3, the electrolyte being rapidly circulated through the nozzle and round the baffle plate placed down the centre, so as to get free circulation.

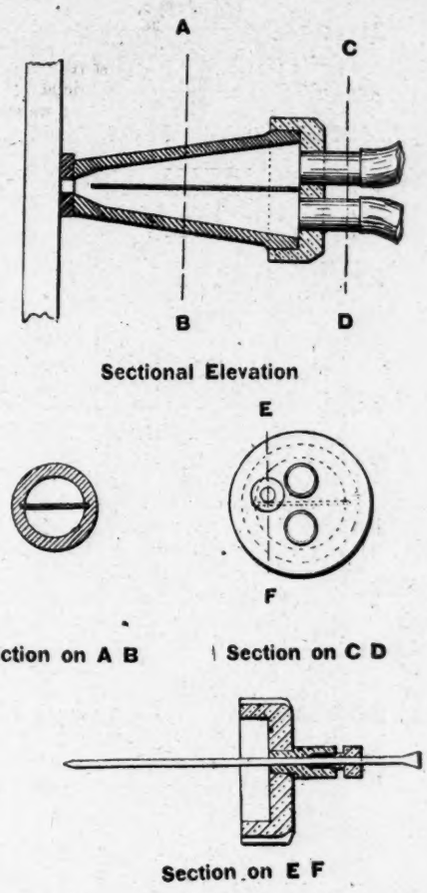


Fig. 3.

A pointed rod, fitted in a gland, is so arranged as to be near the end of the baffle plate; this needle forms the negative electrode, on which the iron is deposited as a powder,

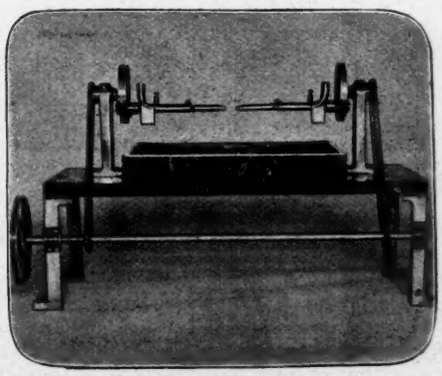


Fig. 4.

due to the high current density, and is washed away by the rapidly circulating electrolyte.

The end of the nozzle is fitted with a rubber washer,

which can be easily removed, and the shape and size of the hole to be drilled is determined by the shape and size of the rubber washer.

Fig. 4 shows a machine designed for cutting out large holes, such as man holes, port holes, &c., the jets of liquid being caused to revolve round the centre.

Some of the best results for iron have been obtained with a solution of sulphuric acid, but good work has also been done with ordinary salt water.

ELECTRICALLY-DRIVEN SHOPS.

By E. BROOK.

The electrical driving of workshops is a subject that is very rarely touched upon by electricians-in-charge, though their experiences must often be very valuable.

In my own case, I have charge of the electrical department of a large engineering and boiler works in the Midlands. We have an average output of 600 units, four generators driving 25 motors, two electrical cranes, 30 arcs, and about 600 16-c.p. lamps. When I took my present situation, about 12 months ago, I was given to understand that I must get the plant put into a thoroughly reliable condition, and place everything on a very sound footing, so that only by something very extraordinary could anything go wrong. I find that engineers want electrical machines to be like engines and boilers, that is, thorough, and so that they will work well on overload, if necessary. Fuses they look upon with no favourable eye, because if every time a motor was started roughly in a boiler shop a fuse were to go, you would require a man to stand by the motor. Likewise, employers do not like to be told every time there is a bit of trouble with a motor, "Oh! we must make a larger motor—this is overworked." Every dynamo and motor here is overworked, though we have no trouble with them now; they are submitted to very rough usage, and stand it. They start at near double load, and must be fused for above that amount.

I got this result by two means — insulation and thoroughness. I found it was better to sacrifice a little efficiency in the armature to get good insulation.

We had three 6-h.p. open type drum-wound motors, that were constantly burning out. The armatures were wound with ·104 wire, and the current density was 3,000 amperes per square inch; they were rewound with ·092 wire and better insulated. Result, slightly lower efficiency, current density 3,910, nine months' run without any attention.

We have a very large planing machine, worked by a 10-h.p. motor, taking (at 110 volts) 80 amperes with the cut, 100 amperes when table is reversing, 150 amperes at point of reverse; the current density in the armature is 3,940 amperes per square inch. This armature was constantly breaking down until I converted it into a gramme wound armature, with the very best results.

A 12-h.p. enclosed motor of a very good type was driving a second large planer taking 80 amperes; armature wire $\frac{7}{17}$ S.W.G.; current density 2,320 amperes to the square inch. This motor, after about one hour's run, would get unbearably hot; I had to take it out and put down a 10-h.p. open type, wire $\frac{7}{18}$ S.W.G., current density 3,150, and that mended the trouble.

I find that brush rockers on motors are worse than useless, as men and lads will touch the machines, with the result that the brushes are often left in the wrong place. I have them all rigidly fixed in their correct position. Oil covers should be made so that they cannot remain open. Brush carriers would be more useful if made suitable for either gauge or carbon brushes, for use with gauze when the motor has to carry more current than the carbon brushes will allow, without heating the commutator. Motors are compelled to work overloaded at times, and an employer will not hear the tale that he cannot add another straw, so to speak, to his motor. If electricity is ever going to be a complete success for workshop use, it must be thoroughly reliable, and inspire confidence in men who do not understand the theory of electrical machinery, as the buyer is the man that must be most considered.

Each length of armature wire is treated with two coats of shellac varnish and baked; the armatures do not look quite so well as when they are varnished at the finish only, when the blemishes are covered up and the holes filled with shellac, which, on the first heating of the armature, is thrown off inside the poles.

All our armature cores and field formers are covered with a thin layer of mica laid lengthways round them. The ends of the cores of slotted armatures are often left with only the usual insulation that is used inside the slot, extending to the corners, with the result that armatures soon get earthed. I remedied this fault by stripping the core and placing fibre washers at the ends, slotting the fibre to suit the slots in the core, and rounding the corners of the fibre.

Fuses are set at about 150 per cent. overload, which must look absurd and amazing to the armchair electrician. The reason is that the steam, towards mid-day, gets very low, causing the voltage to fall, which means a rise of amperage in all the motors, they having to start and work with a greater current. The proper thing to do would be to shut down some of the motors; but no! things must be kept going, and not allowed to break down.

These experiences will show some of the difficult conditions that must be surmounted in workshop practice and a few of the ways of overcoming them.

CORRESPONDENCE.

Destruction of Underground Cables.

With reference to the letter of Messrs. Drake & Gorham in your issue to-day, I can remember some years ago coming across several cases in which the lead covering of cables was quite destroyed, as far as its useful purpose was concerned, after being laid only about a year or so. In one case the damaged cables were laid under the footway adjoining a meat-curing establishment, and the brine used there frequently flowed over the pavement and soaked into the soil, when on coming in contact with the lead covering of the cable a chloride of lead was formed.

In other cases the decomposition of lead seemed to be traceable to electrolytic action, as it was confined to the positive cable, the trouble, of course, being primarily due to the existence of leakage from the conductor to the lead. The lead-covered cables to which I refer were not concentric, and were used for carrying continuous current. They were not armoured, but were laid in bitumen. The result was that the lead was chiefly decomposed at the points where the insulating effect of the bitumen was smallest.

A further repetition of the trouble was avoided by connecting the lead to earth at each end, and wherever lead-covered cables may be laid for continuous current supply, care should be taken to prevent the flow of any leakage current from the lead except at definite points and through properly constructed connections. This is particularly important where the insulation is of such a nature as to depend for its preservation on the lead.

A. A. Voysey.

Electrical Laboratory, Guildhall, E.C.,
July 20th, 1900.

Messrs. Drake & Gorham's letter on the above subject reminds me of a story told by Sir William Preece.

In the early days of submarine cable work, Sir William, then Mr. Preece, wrote a paper on the survey of the ocean bed previous to the laying of submarine cables, in which he advocated that a careful survey of the bottom of the ocean, where the cable was to lie, should be made before the cable was put in hand.

When the paper was read, the President of the Institution, before whom the paper was given, looked up from his chair, and gruffly asked the author if he really meant that the bottom of the ocean was to be mapped out like a piece of land, and when the author replied that he did mean that, the President, so the story goes, grunted, audibly.

Everyone knows now that, in so far as this advice is carried out, in the same proportion is it possible to construct a cable economically.

The same thing applies to underground work. It is a troublesome job to analyse the earth, and the water that pours down into the earth, where cables are to be laid, but economy in cable laying will be roughly in proportion to the thoroughness with which this is carried out.

I also remember the remark of another eminent engineer on another subject.

In the discussion on Sir Edward Reed's channel tunnel project before the British Association, Sir Benjamin Baker remarked that he had a respect, born of experience, for water. The remark exactly expresses my feelings with respect to water. I have a profound respect for it, born of 25 years' experience.

Very early in my electrical career a respect for water was knocked into me, and the feeling has deepened as the years have rolled on.

For pure, unadulterated cussedness, for finding its way into all sorts of places from which the engineer fondly imagines that he has completely excluded it, for finding possibilities of galvanic batteries where it was hoped that none existed, and for generally making itself obnoxious to the innocent engineer, water stands unrivalled.

In some cases the capillary dodge is worked ; in others the water mischievously converts itself into vapour, promptly reconverting itself into its original state as soon as it has penetrated the engineer's fortress, where it performs the usual operation of the enemy who is unsuspected, and attacks the defences with the usual weapons of galvanic action.

Personally I do not like armour. I would rather have the money that the armour costs spent in insulation, or, if it is one of the paper-covered cables, in insulation and lead.

By laying on armour you always run the risk of damaging the insulation that is underneath, in the process of laying it on, and you deprive it very largely of that valuable quality, flexibility, while in many cases you create, with the moisture that will always be present, a galvanic battery, which in one cable, at least, will be acting in the same direction as the leakage current.

It should also be remembered that water has a wonderful facility for absorbing dissolving acids, dirt, and everything that the electrical engineer wishes to keep away from his connections, but which the water will always lead up to them, no matter how careful are the precautions taken to prevent it.

If I may make the suggestion, the Municipal Electrical Association would confer a great boon on its own members, and on electrical engineers generally, if they were to undertake a systematic analysis of the soil, the water that runs into the soil, and the atmosphere above, in every section of their districts.

Sydney F. Walker.

We are rather surprised to see that under the above heading Messrs. Drake & Gorham have thought fit to publish a letter from us to them, without our knowledge or permission, and think, in justice to ourselves, we should state that we simply received an order about four years ago for this cable of a size, quality, and external finish, selected by them without consulting us as to its suitability ; in fact, of a class commonly used for shipwork. We, therefore, did not know how they laid or erected the cable until they wrote recently asking us if we could let them have an explanation of the failure. Had they asked us also how to overcome the difficulty we should have been very pleased to have advised them ; but, so far, they have not acknowledged our letter of explanation, except by publishing it.

The Telegraph Manufacturing Co., Ltd.,
James Taylor, *Director.*

London, *July 25th*, 1900.

Bicycles and Icicles.

I notice in to-day's issue a very interesting question by Mr. Henry James Saint Benno Cunliffe, M.A., Oxon. He says, "Is there no means whereby electricity can be adopted to rotate the cylinders of an ice cream-making machine ?" Although not personally acquainted with the mysteries of that art, my experience in the use of electricity assures me that such a development must be possible, and if he has a little time to spare he may enter upon an inquiry which promises very valuable results.

Let him begin at the beginning, erect a small household crematorium in which to incinerate the daily dustbin material, with this the heat necessary to create his electricity might possibly be obtained.

A statement of the result in ice cream per unit of dustbin refuse would be, I am sure, very acceptable to many of your readers.

A. L. Steavenson.

Durham, *July 21st*, 1900.

Tramway Traction Queries.

I feel sure you will be interested to read the enclosed which I presume is being sent round to several towns that have adopted electric traction. The borough surveyor had a deputation from Leicester who inspected our electric tramways here, and if I remember rightly, took up about half a day of my time. This list of questions, numbering 125, would take probably half a week to answer, and I am not prepared to spend the time.

Alfred S. Giles.

[The portentous document referred to came to us as a "boon and a blessing" ; we have not met with anything so refreshingly cool since the hot wave descended upon us. The list of queries is accompanied by a letter requesting photographs of tramways, power stations, cars, &c. Truly the harassed tramway engineer has much to put up with !—Eds. Elec. Rev.]

Electricity Meters.

I have before me the prospectus of the Schattner Electricity Meter Company, Limited, which has been formed with a capital of £50,000, and has its secretary and offices at Dacre House, Victoria Street, S.W.

Although the document is marked as being for private circulation, nevertheless there is at least one point in it which is, apparently, so open to criticism that you may think it advisable to give the directors an opportunity of explaining it through the medium of your valuable columns.

I am aware, being, as I am, connected with a competing business, that my views may be regarded as biassed ; but I would point out that it is because I am intimately acquainted with this particular business, that I have the knowledge of detail that should render me specially competent to express an opinion.

The company is formed to acquire certain patent rights, and the business, plant, and machinery of Messrs. Schattner and Company, of Norwich.

The prospectus gives no valuation of the plant and machinery, and the statement of net profits earned during a certain period of about six months would, of course, be of more value, were the basis upon which the profits are calculated set out in the prospectus ; there is no apparent means of telling whether rent, salaries, and sundry other necessary expenses have been provided for, except by examining the auditor's report at the solicitor's office in London, which is a privilege of which country investors can hardly be expected to avail themselves.

I may take it, therefore, that the patent rights are the principal asset to be acquired for the substantial sum of £17,800, and it is to these patent rights that I particularly wish to direct your attention.

British patent No. 14,107 is the patent reported upon by counsel in the prospectus, and it is, therefore, probably regarded as the most important patent to be acquired.

In this patent there is described a form of prepayment meter, that probably could not be made to work in practice, unless further inventive ability were displayed in the construction

of the instrument. The sparking due to the gradual breaking of the circuit, after the amount of electricity paid for had been consumed, would quickly burn up the switch contacts, and possibly they would be destroyed on the first operation of the meter, as there is no provision in the patent for a "quick break."

With all due deference, therefore, to Mr. Fletcher Moulton's opinion, it seems to me that the patent is of little or no practical value, for the above reason.

The inventors seem to have soon discovered the difficulty, and on October 27th, 1898, they filed an application for a patent numbered 22,603, for a means of preventing this sparking. According to this invention, they connect the two contacts together, through a high resistance, so that the circuit is never really broken, and, therefore, no sparking takes place.

This resistance also has the effect of dimming down any lamps alight on the circuit, instead of the consumer being suddenly placed in the darkness, and so warning is given that the meter requires to be replenished with more coin of the realm.

Practically the same invention appears to have been protected by two different people more than a year before the date of the Long-Schattner Patent, No. 22,603 of 1898.

I refer to Beaumont's Patent 17,523 of 1897, and Emmott's Patent No. 17,676 of 1897.

Curiously enough, Beaumont was only two days before Emmott in patenting this same idea for dimming down the lamps connected with a prepayment meter by means of a resistance, employed in both cases in substantially the same way as is described in the Long-Schattner patent more than a year later.

There is no mention in the prospectus of an arrangement having been come to with either Mr. F. J. Beaumont or Mr. Walter Emmott, and even if there were, it is not altogether evident how any such arrangement could render the Long-Schattner patents valid, and of course the validity of some of the foreign patents—not all—are probably adversely affected by the existence of any British anticipations.

I may be wrong in my conclusions, but if so the directors will doubtless be glad of an opportunity of correcting me. Anyhow, I am quite sure of my facts.

Chas. O. Bastian.

London, N.W., *July 22nd*, 1900.

The Inst. E. E. and Sunday Observance.

I have recently received from the Institution of Electrical Engineers a circular announcing the proposed arrangements for the entertainment of the members of the American Institute of Electrical Engineers who will be visiting this country during August.

It is with the deepest regret and concern that I note the first item on the programme, viz., a trip up the Thames on *Sunday*, August 12th. The hope is expressed that a large number of members and ladies will take part in the proceedings, in order that a "true British welcome" may be given to the guests!

It is quite foreign to all the traditions of this country for a leading scientific society to give an entertainment upon a Sunday, and I cannot but feel that a more truly typical British welcome—all the heartier because of the freedom from conscientious scruples—would be extended to the visitors upon any other day of the week.

Perhaps it is not even yet too late to remedy the matter, and thus save the Institution from establishing so discreditable a precedent, which will bring dishonour upon the country, and cast a stigma upon the profession.

A Christian Briton.

July 25th, 1900.

PARLIAMENTARY COMMITTEES.

Electric Lighting in Limehouse and Mile End.

On Wednesday, Thursday, and Friday last week, the Select Committee of the House of Lords, presided over by the Earl of Camperdown, considered Provisional Order No. 10, which was to confirm the provisional orders for the lighting of Limehouse, Mile End Old Town, and St. George's-in-the-East. The whole of the districts, with Whitechapel, will, under the new Local Government Act, shortly be merged into the municipality of Stepney, and the Bill was the result of local action in the parishes concerned to have the whole of the lighting of the new borough carried out in connection with the present station of the Whitechapel Vestry.

Mr. Worsley Taylor represented the local authorities, and explained that the only opposition came from the County of London Electric Lighting Company, which, in 1897, obtained a provisional order for the supply in Limehouse, Mile End Old Town, and St. George's-in-the-East, but up to the present counsel stated that the company had done nothing to carry out their obligations.

Major P. Cardew was called, and gave evidence in support of the order. He considered that the generating station of the Whitechapel authorities was a good one, and the site was capable of being utilised so as to give ample plant for the supply of electricity to the whole of the new borough. From a commercial point of view, he would say the advantage would lie with the Corporation in supplying the district from Whitechapel rather than with the company, which had to bring the electricity from the parish of St. Luke's. The County of London Company, he considered, had deliberately decided to attempt to bring the current from an outside district, and if they were foiled by the intervening local authorities, they must abide by the result.

Other evidence was called, including that of Mr. W. Jameson, the surveyor to the Whitechapel Vestry, who stated that they now had a quantity of machinery on order which would quadruple the power of the station.

Mr. W. Braithwaite was called for the County of London Company, and stated that with all their efforts they had failed to get wayleaves to carry the current from St. Luke's to the districts concerned till recently. They had now secured at considerable cost a wayleave from the canal company, and they were prepared to lay down plant at once to carry out the obligation.

Mr. C. P. Sparks, engineer for the company, gave similar evidence, and added that having now obtained wayleaves it was proposed to lay down four conduits. The company had adopted the two-phase system in order to give a supply to the East-End districts.

Mr Sydney Morse, solicitor to the County of London Company, gave a history of the electric lighting orders in question, and charged the local authorities and the County Council with obstructing the company.

Counsel having addressed their Lordships, the Committee decided that the Bill should proceed.

Walsall Tramways.

The Select Committee of the House of Commons, presided over by Colonel Gunter, considered the Omnibus Bill of the Walsall Corporation, which, amongst other things, would give the Corporation power to re-equip the existing tramways, and make extensions both inside and outside the borough at a capital expenditure of £160,050.

The Committee passed the preamble of the Bill.

Blackpool, St. Anne's and Lytham Tramways.

The Blackpool, St. Anne's and Lytham Tramways Bill came before Lord Morley's Committee of the House of Lords as an unopposed measure on Thursday last week. The Bill gives power to greatly extend the tramway system between the places mentioned at a cost of £50,000, and to work the same with electricity.

Huddersfield Tramways.

On Friday last week, the Huddersfield Corporation Tramways Bill passed Lord Morley's House of Lords Committee on Unopposed Bills. The Bill asked for power to enable the Corporation to extend the existing tramways both inside and outside the borough, and to substitute electric traction for the existing steam traction. The capital powers asked for under the Bill were £399,000.

Glasgow District Tramways.

The Glasgow District Tramways Bill, promoted by Mr. W. M. Murphy, which has already passed the House of Lords, and which was last week before the Court of Referees, as reported in the Electrical Review of last week, on Thursday and Friday came before Sir Lewis M'Iver's Committee of the House of Commons. The Bill is to authorise the construction of a series of electric tramways in and around Paisley and Renfrew.

Mr. Pembroke Stephens contended that the Glasgow and Renfrew District Railway and the Paisley and Barrhead District Railway would not be affected by the scheme which they were opposing, and the experience of the past few years had shown that where large railway companies had opposed electric tramways they always failed in their opposition, because the character of the new traffic was different.

Mr. W. Barrington, the engineer of the scheme, said the gross estimate for the scheme, after taking into account the obligations that had been placed upon the promoter by local authorities, was £227,669. The capital was raised.

A good deal of local evidence was called to show the utility of the scheme, and Mr. W. M. Murphy, the promoter of the scheme, expressed the opinion that the tramway would pay.

Evidence was then called in opposition to the scheme to show that the railways would be injuriously affected by the competition, and after addresses by counsel,

The Chairman said the Committee were struck with the fact that the scheme was a good one, and the opposition had made no impression upon their minds, but they realised that the promoter had been encountered by a large number of different local bodies with conflicting views, and with different degrees of rapacity. One line had to be given up because it was opposed by that powerful municipality the Glasgow Corporation, and another had to be given up to the tender mercies of Renfrew with no assurance that Mr. Murphy would ever be able to make it. Yet another line remained in the air, obviously with the purpose of joining up the Corporation tramways of Glasgow when that Corporation managed to bring its boundaries to the west side of Govan or even to the borders of Paisley. What practically remained was an excellent line out to Johnstone. That was all that was left of the scheme, and it was the result of a system which amounted to blackmail on the part of the local bodies. It seemed to the Committee of little doubt that local authorities, with the exception of Glasgow, approved of the undertaking, and they were very glad that a gentleman with experience and capital came to provide the scheme, but they hid their joy from Mr. Murphy, and meant to screw as much out of him as they could. It seemed that what went on was that each of the three or four conflicting bodies fought for its own hands, each determined to make a profit no matter whether the scheme itself made a profit or not. What with agreements and clauses added in the House of Lords, many of which were conflicting, the Bill would allow a highly artistic, but not properly-clothed advertisement to pass through the streets of Paisley on a car, but the advertisement might be stopped on the border of Renfrew, and kept with its face turned to the wall until the car returned again to Paisley. Personally, he thought the business of a municipality was not to sell wayleaves, but to maintain the roads for the use of the public, and the question of the legality of such changes as were proposed in the Bill might be raised. He asked Mr. Murphy in the face of all those things whether he considered the scheme worth while going on with.

Mr. Murphy said he did not think the workability of the undertaking had been very seriously affected, but he had no reason to be more enamoured of the scheme than he was before.

The Committee then deliberated in private, and on the proceedings being resumed, the Chairman said: The Committee find that the preamble of this Bill is not proved, but they desire to put on record that in their view the original scheme was a good one, and calculated to be of much use to the district, but it has been so mutilated and loaded with conditions by conflicting interests and the excessive demands of several local bodies that at present it appears to the Committee to be wholly unworkable.

Municipal Trading.

The Joint Committee on Municipal Trading sat again on Friday last week, the Earl of Crewe presiding. Evidence was given by Mr. Shepherd, representing the building trades, and Mr. Waterlow, chairman of the Housing Committee of the London County Council.

Mr. G. C. Kingsbury, Mayor of Blackpool, replying to the Chairman, said that among the enterprises which the Corporation possessed were the gas works, electric lighting works, markets, and tramways. The electric lighting undertaking had been established some seven years. They had a capital of £117,000, and had accumulated a sinking fund of over £9,000. The income for the seven years amounted to £74,000, and the gross profits to £28,000. The net profits were £3,200, the average net profit amounting to 1 per cent. on the outlay annually. The street lamps were lit at cost price; the meters were given free. In 1894 they started with some 56 customers. The price was 6d. per unit. Now they had over 900 customers, and the price varied from 7d. to 2d., the average being under 3d. per unit. The customers were nearly one in 50 of the population, and one in 10 of the houses had the light.

Have you any demand for power?—Yes, but it is limited in Blackpool, as we have no manufacturers. There are some small works, printing works, &c., to which we supply power.

Continuing, Witness said that the fact that the Corporation owned the gas works had in no way retarded the development of the electrical industry in Blackpool. So far from the gas hampering the electric light, they found that the one stimulated the other, and the public obtained great benefit by reason of the fact that they were both in the hands of the Corporation.

By Mr. Grant Lawson: The streets of Blackpool had been lit by electricity longer than any town in England; it was the domestic supply which had been in operation for seven years only.

By the Chairman: Regarding tramways, he regarded Blackpool as being in an improving position. The Corporation had had control of the trams now for eight years. Not only was Blackpool the first town in England to adopt electric lighting in the streets, but it was also the first English town to adopt electric traction for its trams. Originally, the tramways were worked by a company, but after seven years' successful working, the Corporation exercised their powers of purchase, and bought out the company on terms fixed in the original agreement. As a Corporation, they had had the trams working for eight years. The capital outlay was £98,000, and the income for the eight years had practically equalled that amount—all but £2,000. The gross profit for the eight years had amounted to £31,000, and the net profit to £13,000, the average annual net profit being equal to about 3 per cent. on the outlay.

Does that go to improving the concern?—Largely. There has been a very small surplus divided in relief of the rates—some £3,000 in the whole time.

Have you lowered your fares?—The fares are extremely low, and the Corporation has extended the system very much as compared with the old system of the company. Last year we carried 3,400,000 passengers.

Replying to further questions, Witness said he was there to specially represent the borough of Nelson, who owned their electric lighting, which was initiated by them in 1893. It cost altogether £30,000, £10,000 of which had been spent, and £20,000 of which was being spent. The price charged was 5d. per unit less 5 per cent. discount, and for motive power 2d. The works had just begun to pay.

The Committee then adjourned.

At the meeting of the Committee on Tuesday, Lord Morley, chairman of Committees in the House of Lords, gave evidence as to the procedure adopted by that House towards the promoters of Bills. He expressed the opinion that an amendment was needed in the Tramways Act of 1870. The time of purchase should be lengthened, because the cost of laying down an electric tramway was much larger than the cost of a horse tram. There was nothing to prevent a Corporation making a tramway and calling it a light railway.

The Chairman: On the question of electric lighting orders we have had a great many complaints from witnesses that local authorities, particularly the smaller ones, have obtained orders and not used them.

The Witness said he had heard the same complaints, and although the Board of Trade had the power to revoke the order, that power was used very sparingly. He would suggest that there should be a limit put upon the time for the completion of the works, the same as in the case of a railway, and if at the end of the time the works were not completed, the undertakers should go to Parliament or the Board of Trade and ask for an extension. To obtain that extended time they would have to bring good and distinct reasons, and failing their being able to do that, they would have to make way for somebody else. He thought it desirable that Parliament should lay down some definite rules as to how far municipalities should be allowed to trade, particularly outside their own limits.

Mr. Campion, examiner of Bills and taxing master, in the House of Commons, spoke as to the large increase in the number of Bills lodged with Parliament of late years, due, he thought, in a large measure, to the applications from municipalities who wished to embark upon public enterprises.

Sir Robert Hunter, solicitor to the General Post Office, explained the legal position of the Postmaster-General in regard to the telephone service at Glasgow. He said that the National Telephone Company had a license to transact telephone business within an area which included Glasgow and suburbs, and the Corporation of Glasgow had lately received a similar license from the Postmaster-General to carry on telephone business within the same area. In neither case did the license give the licensee power to take up streets. Under Section 5 of the Telegraph Act of 1892 the Postmaster-General could authorise any of his lessees to exercise the same powers of constructing telegraphs in and under streets which he possessed, but in neither case could those powers be exercised without the consent of the local authority. In 1892 the Government of the day came to a general arrangement with reference to the telephone business of the country, and the general outline of the agreement was that the trunk wires which connected different towns should be worked by the Postmaster-General, and the business inside towns, which was generally called exchange business, should be left in the hands of private companies — not in any way securing those companies against competition, but assuming in the main that the business would be done by companies. As part of the general arrangement, certain agreements were come to in reference to the taking up of the streets. The Postmaster-General agreed that he would confer upon the National Telephone Company the powers which he himself had to take up streets, and he also agreed that he would lay pipes for the telephone companies connecting two or more exchanges in the same area. That last agreement was in pursuance of a declaration contained in a Treasury minute which was laid before Parliament in 1892, in which the general policy was explained. In Glasgow the Postmaster-General had never granted the National Telephone Company his license to exercise wayleave powers, and the company had never applied to him for permission. The Postmaster-General applied to the Corporation for its consent to lay pipes underground to connect the exchanges of the company, but the Corporation said that they would only give their consent on condition that the wires were not to be used for the purpose of telephones. Witness said that, of course, the Postmaster-General could not give any such undertaking, and ultimately the consent of the Railway Commissioners was obtained for the execution of the work. In the meantime the Glasgow Corporation themselves had obtained a license from the Post Office for a telephone service, and they had applied to the Postmaster-General for his authority to execute underground works, and that authority would be granted shortly. As to the reasons for the Corporation wishing to start a telephone service, he believed it was alleged that the service of the National Company was inefficient, but he (the witness) was not prepared to express any opinion on that point. The Corporation had not yet commenced their service, but he believed that they had about 2,000 subscribers promised, and as far as a third party could tell there seemed to be a promise of a brisk competition, and the effect of that might be that the Corporation would eventually buy the company out. Generally speaking, competition in regard to telephones was only desirable as a means for improving the service. In conclusion, Sir Robert said he did not consider that the municipality of Glasgow had the grievance

against the Post Office which the Lord Provost had put before the Committee.

Mr. J. Williams Benn, the chairman of the Highways Committee of the London County Council, gave evidence with regard to the tramway system of London. He said that as successors to the Metropolitan Board of Works the County Council found that from time to time they were able to purchase the tramway undertakings of London. When the Council came into power it found London very badly served by 13 companies, mostly disconnected, and dumped down in districts irrespective of the general convenience of London. They had exercised their powers of purchase where possible, and that policy continued, so that in the space of a few years the Council would be the owners of all the tramways in London. There were 115 miles laid down, and of these 72 had already been purchased, the remaining 43 still being in the hands of the companies. Of the 72 belonging to the Council, 48 miles which were on the north side of the Thames, were leased to the North Metropolitan Tramways Company, and the others which were on the south side of the Thames were worked by the Council. The lease granted to the North Metropolitan Company would terminate in 1910. To purchase the lines and the depôts of the North Metropolitan system the Council had to pay £817,000; the 24½ miles on the south side of the river cost £889,943, but in that case they purchased the whole of the undertaking. The witness then gave particulars of the lease granted to the North Metropolitan Company, and said that there was a clause in it to the effect that in the event of electrical traction being introduced the Council were to have a certain percentage of any increased receipts that might accrue.

The Chairman: Has there been any step taken in that direction?—Yes, during the present session a Bill is passing through Parliament to enable us to convert the whole of the existing tramways of London into electric traction.

Continuing, Witness then gave particulars of the receipts which the Council derived from the trams, and pointed out that, so far as the financial result was concerned, the policy of working the trams themselves was better than that of leasing.

The Chairman: You are proposing to convert your tramways to electrical traction?—Yes. I am very glad to say that there is every prospect of those Bills getting through your Lordships' House.

Do you hope for good results from that?—Yes, very important results; and I may perhaps just give you a few figures of the receipts and expenses on the Council's Southern system under horse traction. The receipts per mile run are 10·64d., and the expenses 8·52d., that shows a profit of 2·12d. per mile run, and that in face of the fact that our fares are extremely low. Our average fares are a trifle over a ½d. per mile. It is assumed that if the lines were converted to electrical traction, the receipts would be at least 12d. per mile run, and the cost of working would not exceed 6½d., leaving a profit per mile run of 5½d. The present profits of horse traction are 2·12d., so that the extra profit resulting from the conversion is estimated to be not less than 3·38d. per mile run.

Continuing, Witness said that it was the universal experience that a greater mileage was obtained from an electrical service than a horse service, but assuming that at least as many miles were run by electrical cars as by their present horse cars, they would get an addition to their revenue on the southern line alone of £140,633; out of that of course would have to be paid the extra interest upon the capital outlay estimated at £150,000, and they would have to make provision for the repayment of the capital within 25 years, but after allowing for those deductions they would have an extra profit upon the southern lines, which were only one-fifth of the present system of London, of £79,000. As to the system to be adopted the Council had, he said, gone to considerable trouble and expense in examining the various systems which were to be found in working, and they had sent Dr. Kennedy to America and the Continent, who had arrived at the conclusion that for London it would be necessary to have an underground system, the two most suitable being the conduit and the surface-contact systems. Of course, in time electric traction might be applied to the northern system of tramways, and the Council hoped that at an early stage they might get the company to introduce it.

The Committee then adjourned.

London County Council Tramways.

On Friday and Monday the House of Lords' Committee, under the chairmanship of the Earl of Camperdown, considered the London County Council's Tramway Bill, which has already passed the Commons. The Bill is to empower the Council to make 11 extensions on the north of the Thames in connection with the existing tramways in the hands of the Council, to double an existing line at Nine Elms Lane, and to erect a generating station at Camberwell for the purpose of working sections of the existing tramways by electricity.

It was explained that of the 115 miles of tramway in London the Council owned 72½, of which 48 miles on the north side of the Thames was leased to the North Metropolitan Tramways Company, while if the present policy was continued, by 1911 the whole of the existing tramways would have been acquired. It was the intention to work the trams electrically, and for that purpose it was proposed to lay down experimental lines on the south side of the Thames on which various systems of underground traction could be tried. In the outlying districts the overhead trolley system was contemplated.

The Bill was opposed by the South Metropolitan Gas Company and the Lambeth Water Company, who feared that the proposals would cause electrolysis of their mains. There was also opposition by the Lambeth and the Wandsworth Vestries in whose districts the experimental lines would be constructed, and it was asked that the local authorities should have some voice as to the system of traction which might be adopted.

After hearing evidence the Committee passed the preamble of the Bill, but inserted certain clauses for the protection of the gas and water companies.

On Tuesday Lord Camperdown's Committee of the House of Lords considered the London County Tramways, No. 1, Bill, which, like the No. 2 Bill, considered the previous day, sought for power to enable the Council to substitute electric traction for the present horse traction on the lines now owned by them, and also to construct various lines to connect up the various trams. The Committee passed the preamble of the Bill.

Newcastle-on-Tyne Electric Supply.

Lord Brassey presided on Tuesday over a Select Committee of the House of Lords to consider a Bill to confer further powers upon the Newcastle-on-Tyne Electric Supply Company, Limited, and for other purposes. Mr. Pember, Q.C., appeared for the promoters, and Mr. Moon for the County of Durham Electric Supply Company, who petitioned.

Mr. Pember, Q.C., said he had come to a settlement in the matter, and therefore would only give formal proof, after which an amendment would be brought up. The promoting company had been supplying electricity for a great many years in the borough of Newcastle-on-Tyne, under a provisional order, and it now sought certain powers in respect to the north side of the Tyne. It would be a very elaborate matter if he were to go into it; but as he had agreed to settle the only opposition left, it would not be necessary to do that, and he would just put in a formal witness.

Mr. Merv, vice-chairman of the promoting company, said his company had been supplying electricity in Newcastle a great many years under an electric lighting order, and they now sought to extend their operations in various places north of the Tyne. They did not intend to go south of the Tyne, but, as was stated in the preamble of the Bill, there was great need for electricity north of the Tyne. The only petition against the Bill was that of the County of Durham Electrical Supply Company, and they objected to Clause. 13. As, however, it had never been the intention of the promoters to supply south of the Tyne, they were quite willing to so amend the clause as to meet the wishes of the petitioners. They would amend the clause so as to make it clear that they would not trench upon the County of Durham Company's province on the south side, and the Durham Company were ready to consent to certain alterations in their Bill so as not to trench on the promoters' province north of the Tyne.

Mr. Moon, for the County of Durham Electrical Supply Company, concurred in the suggested arrangement, and said his clients were quite willing to alter their Bill so far as was necessary so as to confine them within the limits suggested.

The Committee then passed the preamble of the Bill and adjusted the clauses.

Rochdale Tramways.

On Tuesday the Rochdale Corporation Bill, which has already passed the Commons, was considered by a Committee of the House of Lords, under Earl Camperdown, when a clause was considered for the protection of the Lancashire and Yorkshire Railway Company, who owned a great deal of property in the borough of Rochdale, and who protested against being rated for loss in the working of the tramway outside the borough. The Committee rejected a clause submitted to the effect that if the tramway outside the borough was worked at a loss, the company should only be assessed at a quarter of their rateable value in respect of that loss, but they approved of a clause to the effect that the Corporation should each year, after the first two years' working, prepare a statement and balance-sheet of the tramways account, and if in any year the revenue exceeded the expenditure the Corporation should carry such excess to a reserve to be used in providing for deficiencies and contingencies. Should there be a deficiency in any year, this should be provided for in the estimate for the following year, and reduced gradually over a period of years not exceeding five.

LEGAL.

Crystal Palace District Electric Supply Company.

In the Chancery Division of the High Court of Justice on Saturday, a petition by shareholders in the Crystal Palace District Electric Supply Company for a reduction of the capital came on for hearing before Mr. Justice Kekewich.

Mr. Warrington, Q.C., who appeared for the petitioning shareholders, said that this was a petition for the reduction of capital. It was before his Lordship on the 7th inst., when it was adjourned for evidence of the depreciation of the assets. An affidavit was filed on the previous day on the general question of whether the reduction would operate fairly on the shareholders. There was a fully paid up share capital of £28,586. It was proposed to reduce that to £2,858, a loss of 18s. per share. There was a loss in working of £14,885 16s. 5d., and there was a loss in the depreciation of assets of £11,000. That £11,000 added to the £14,885, more than made up a sum of £25,885, which was more than the loss

required. In addition there was a sum of £1,600, which appeared in the accounts of last year under the head of preliminary expenses and losses on working, that had been struck out in the last account. An account had been put in showing that this was a loss on working also. Counsel proceeded to read affidavits in support of his case. They set forth that it was almost impossible, under existing circumstances, for the shareholders to receive interest for many years to come. For three years the undertaking had been carried on by money provided for working capital. The proposed reduction could be no hardship even to the shareholders who objected.

Mr. Renshaw, Q.C., who appeared for Mr. Chapman, a dissentient shareholder, submitted that this was not a case in which the Court ought to sanction a reduction. It would operate unfairly on the shareholders. There was no sufficient evidence as to the loss in carrying on the concern which would justify this reduction of capital. The affidavits did not carry the matter any further. This was a case in which the jurisdiction of the Court was discretionary, and the dissentient shareholder was entitled to be heard in objection.

His Lordship, in giving judgment, said he was not disposed to ignore or depart from the opinions expressed by Mr. Justice North and the Court of Appeal in the cases cited before him. Some companies spent enormous sums in connection with the floating of their undertaking. Here it had been proved satisfactorily that what were put in as preliminary expenses were not those at all. Now that a valuation had been made they knew that the depreciation and the actual loss of the capital between them made up the full amount by which it was proposed to reduce the capital of the company. So far as any answer to that part of the case was required, he thought it was proved by Mr. Barker's affidavit. He valued it as a going concern, when everything was fairly taken into consideration. The other point was a much more important one. That was the point dealt with by the Lord Chief Justice Cotton in the matter of the Direct Spanish Telegraphic Company. The learned Lord Chief Justice said that in his opinion, if he saw it bore hardly on those who did not consent, he ought not to sanction a scheme simply because the creditors were being dealt with properly. In the present case there was one dissentient shareholder, a Mr. Chapman, who had 40 shares. But there no was doubt that this reduction of capital would get rid of the burden on the company by reason of the arrear on the debentures. It would enable the company to start fair. How did this bear hardly on Mr. Chapman, or any other shareholder who did not consent? He was satisfied that what had been done had been done honestly; that the depreciation and loss had been sufficiently proved. It could not be said that it bore hardly on those who did not consent. Under these circumstances he must sanction the resolution.

Mr. Warrington asked that Mr. Chapman's costs might not fall on the company.

His Lordship: No; he must protect himself.

The Blahnik Arc Light Company.

In the Court of Chancery last Friday, the case of Burke *v.* the Blahnik Arc Light Company came on for hearing before Mr. Justice Kekewich.

Mr. Chubb said this was an application for the appointment of a receiver and manager on behalf of the plaintiff, Mr. Burke, who was the holder of two debentures amounting to £250, out of a total issue of £5,000. They were due because the interest was in arrear for more than three months. Under the terms of the debenture they then became due. They were a charge on all the assets of the company. The company manufactured goods connected with electric lighting. The urgency was that the company was in financial difficulty. Various actions were being brought against it. Judgment had been recovered in three actions, and the plaintiffs were about to issue executions against the company. It was, therefore, in the interest of the debenture holders that a receiver and manager should be appointed.

His Lordship appointed Mr. W. H. Chantrey.

Simon *v.* Conze.

In the Queen's Bench Division on Monday, before Mr Justice Mathew and a special jury, the action of Simon *v.* Conze came on for hearing. Mr. S. Cooper appeared for the plaintiff, and Mr. R. Neville for the defendant.

Mr. Cooper, in opening the case, said the plaintiff was Mr. Philip Frederick Wm. Simon, and the defendant Mr. Emil Conze. The plaintiff sought to recover damages for alleged breach of an agreement by the defendant not to canvass the plaintiff's customers. The defendant denied the breach, said he was entitled to act as he had done, and counterclaimed for £50. The plaintiff, Mr. Simon, was an electrical engineer, now carrying on business with Mr. Berry, under the name of Simon & Berry, in Upper Thames Street. Defendant, who was formerly his partner, was now partner in another firm. The partnership between plaintiff and defendant existed from 1894 to 1896, and they were, during that time, agents for the sale of the manufactures of Messrs. F. & W. Busch, of Germany. They had, besides that agency, many general customers of their own with whom they did business, but who were hardly distinguishable. About the beginning of September, 1896, the defendant Conze went to Germany, and unknown to his partner, made arrangements to enter the firm of F. & W. Busch. When he came back he told his plans to the plaintiff, and a dissolution of partnership was agreed on. The dissolution agreement was dated December 23rd, 1896. It recited that the sum of £374 1s. 6d. was the defendant's share, and that he was to retire as from October 1st, the business to be carried on by Simon. The sum of £200 was to remain in the business on loan at 4 per cent. Clause 4 of the agreement provided that Conze should not within the City of London or within two miles thereof for five years carry on a business of a like or similar character to that hitherto carried on between the parties, and should not directly or indirectly canvass or endeavour to obtain customers from among the customers of the old firm of Simon & Conze, or who hereafter might be the customers of Simon. It was thus arranged that Simon was in future to be the agent of the German firm. Then about six months afterwards Mr. Simon took Mr. Berry, his present partner, into partnership with him, and the business was greatly developed. Then there occurred friction between Messrs. Simon, Berry & Co. and the defendant, and Mr. Berry, knowing that their contract with Messrs. Busch & Co. might be terminated at a moment's notice, took the precaution of seeking additional sources of supply, and also arranged to manufacture the goods. Another reason for doing so, was that the firm in question did not always supply them up to time. In July, 1899, the agency was cancelled, and a Mr. Paul Eich, who had formerly been book-keeper with Messrs. Simon & Conze was appointed London agent to Messrs. Busch. The latter firm in September, 1899, sent out a circular to plaintiffs' customers amongst others, saying that they had transferred their agency in the United Kingdom and the Colonies to Mr. Eich; and a second circular was sent out by Eich from 52, Cannon Street to the same effect. Both these circulars, plaintiffs contended, were in contravention of the arrangement under which the partnership was dissolved. The effect of them was of a very damaging character to plaintiffs' business, and he brought the present action in consequence.

Counsel having read the correspondence between the solicitors to the parties, his Lordship asked if some arrangement could not be come to.

Mr. Neville said there were other actions pending before the Official Referee.

Ultimately, counsel for the parties adjourned to his Lordship's room where an arrangement was arrived at, the terms of which were not stated in Court, and the jury was discharged.

The Attorney-General *v.* the National Telephone Company, Limited.

In the Queen's Bench Division of the High Court of Justice on Tuesday (July 24th) this case was down for hearing before Mr. Justice Darling and Mr. Justice Kennedy, sitting as a Divisional Court. The Attorney-General on the motion of the London County Council, filed an injunction against the National Telephone Company for opening and breaking up streets within the administrative county of London without the consent of the County Council and the license of the Postmaster-General. As the company contended that in what they had done they had been acting within their legal rights, pleadings were prepared in order that the question might be tried, and the case was set down in the Revenue paper for hearing. It was fixed to come on for argument, but after a brief consultation between counsel, a settlement was arrived at.

The Attorney-General, the Solicitor-General, and Mr. F. T. Daldy appeared for the Crown, and the defendant company were represented by Mr. Joseph Walton, Q.C., and Mr. Roskill.

The Attorney-General said his learned friend, Mr. Walton, had communicated with the Solicitor-General and himself, and they had arranged the terms of settlement if their Lordships would allow the information to be disposed of in that manner. The terms were (1) a declaration (in the terms of paragraph 1 of the information) that the defendants were not entitled to lay any pipes, wires, cables, or apparatus for telephonic purposes under any of the streets in the county of London unless by license of the Postmaster-General under the Telegraph Acts, and with the consents required by those Acts; (2) an injunction restraining the defendant company, their officers, servants and agents from opening or breaking up any street or public road within the meaning of the Telegraph Acts, 1863 to 1899, within the administrative county of London or any part of such street or public road for the purpose of extending the company's present system of underground pipes and wires, &c., without the authority of the Postmaster-General and the consent of the London County Council for such purposes described by the Telegraph Act of 1892; and (3) the defendant company to pay the taxed costs.

Mr. Walton, Q.C., on behalf of the Telephone Company, said he assented to those terms by which they put an end to a long controversy on the subject in the interest both of the Telephone Company and of the Crown.

The Court sanctioned the agreement.

BUSINESS NOTES.

Air Compressors and Hoists.—We have received a booklet from Messrs. Reavell & Co., Limited, of Ipswich, describing their high speed air compressors, suitable for working at 80 to 100 lbs. pressure for operating pneumatic tools, hoists, &c. The compressor consists of four cylinders, arranged radially in a circular casing, fitted with trunk pistons, and driven by a common crank-pin. An automatic regulator controls the air pressure. The machine is well adapted for direct coupling to an electro-motor, but is also arranged for belt driving. Pneumatic hoists for workshops are also illustrated.

Electrical Wares Exported.

WEEK ENDING JULY 25TH, 1899.	
Alexandria	Value £59
,, Teleg. mat.	64
Amsterdam	100
Bangkok	28
Bilbao	45
Boca. Teleg. mat.	712
Bombay. Teleg. mat.	96
Boulogne	62
Bremen	189
Buenos Ayres	299
,, Teleg. mat ..	269
Calcutta	99
Cape Town	187
Colombo	747
Durban	74
East London	12
Gibraltar	35
Hamburg	117
Jersey and Guernsey	60
Odessa. Teleg. mat.	60
Ostend	10
Port Elizabeth	397
Port Said	593
Rouen	420
Sydney	221
,, Teleph. mat.	400
Wellington	32
Yokohama. Teleph. mat. ..	150
Total ..	£5,507

WEEK ENDING JULY 24TH, 1900.	
Alexandria	Value £104
Azores. Teleg. cable ..	166,000
Bangkok	144
Boca. Teleg. mat.	197
Bombay	230
Buenos Ayres	1,769
,, ,, Teleg. mat. ..	452
Calais	45
Calcutta	805
,, Teleg. wire	182
Cape Town	212
Christiania. Teleg. wire ..	39
Christiansand. Teleg. cable ..	63
Colombo	75
Copenhagen. Teleg. wire ..	161
Durban	288
Gibraltar	78
Hamburg	24
,, Teleg. mat.	350
Hong Kong. Teleg. mat. ..	51
Launceston	145
Melbourne	38
Ostend	300
Rio Janeiro. Teleg. mat. ..	682
Rotterdam. Teleg. mat. ..	150
Singapore. Teleg. cable ..	13,000
,, Teleg. mat. ..	357
Sydney	295
,, Teleg. mat.	174
Wellington Teleg. cable ..	120
,, Teleph. mat. ..	2,261
Yokohama	475
Total ..	£188,250

Foreign Goods Transhipped.

Brisbane. Teleph. appa.	Value £900
Gothenburg. Teleph. appa. ..	90
Port Elizabeth. Telephones ..	25
Total ..	£1,015

Austria.—The Union Electrical Company, of Vienna, have secured a concession to establish and operate a large central electric lighting station in the town of Aussig.

Belgium.—A company has just been formed in Brussels with a capital of £10,000, to be known as La Société Internationale du Gaz Economic et d'Electricité.

Books Received.—"Traité de Magnétisme Terrestre," by E. Mascart. Paris: Gauthier-Villars. 1900. 15 francs.

Catalogues, &c.—We have received a pamphlet from the Rankine Patent Feed Water Filter Company, Limited, describing various patterns of their filters. These comprise simple and compound filters, the latter being either double or triple; the filtering material is drawn over light cartridges, which are easily handled, and are interchangeable. It is claimed for them that they are simple in construction, have great filtering area, occupy small space, and can be cleaned in a few minutes; besides being used in a great many steamships, a large number have been applied to electrical and other plants on land.

The London Electrical Fittings Company send us a leaflet describing their new high voltage wall plug, which has been designed with a view to combining strength and simplicity at low cost. The base is of porcelain, which is not threaded, and is of simple construction; the pins are separated by porcelain fillets.

Condensing Plant for Hot Countries.—Messrs. Dick, Kerr & Co., Limited, London (the contractors for the Calcutta electric tramways), recently placed an order for a Klein's condensing plant with patent fan draught cooling tower. The plant is designed to condense the exhaust steam from engines of about 2,000 H.P., and consists of a surface condenser with Edward's air pumps and motor-driven circulating pumps. The cooling tower is of Messrs. Klein's latest type, specially designed for giving the highest efficiency in hot climates. The Klein Engineering Company have also in hand several water coolers for erection in South Africa.

The Copper Market in July.—The last issue of Messrs. H. R. Merton & Co.'s statistical circular shows that stocks have decreased by 1,219 tons during the first half of the current month, while the price of G.M.Bs. has advanced 10s. per ton. The fall in stocks is chiefly due to the low shipments from America to Europe, the total being only 4,834 tons, as compared with a fortnightly average of 8,943 tons in June. The shipments from Chili and from "other countries" are also disappointingly small, and had not deliveries during the first half of July been considerably lower than during the past five months, there would have been a still more marked depletion of stocks. The total supplies have, however, reached within 969 tons of the total deliveries, and adding the 256 tons of Standard shipped to America, the 1,219 tons by which stocks have been decreased are accounted for. The price of G.M.Bs. has advanced from £71 15s. to £72 5s. per ton, during the first 15 days of the month, in sympathy with the shrinkage of visible supplies. The stocks on July 16th totalled 28,044 tons, as compared with 29,263 tons on July 1st. No new mining companies have been floated during the first half of the month.

Outings.—The employés of Messrs. Page & Miles, Limited, electricians, of Brighton, held their annual outing on Saturday. The party, numbering in all about 52, proceeded by train to Fittleworth, where various amusements were indulged in during a long and enjoyable day.

Messrs. Ward & Goldstone's annual employés' picnic is to take place to-morrow, when 100 of the workpeople will enjoy a visit to Blackpool.

Gas Explosion.—Early on Wednesday morning an explosion occurred in a street in Manchester, followed by other explosions, and the outbreak of a fire in an adjacent hat factory. It appears that some gas which had escaped was ignited by an electric spark. The fire was soon extinguished.

Spain.—Tenders have just been invited for the concession for the electric lighting of the town of Mondragon (Province of Guipuzcoa).

Trade Announcements.—Messrs. Geipel & Lange, of Parliament Mansions, S.W., have been appointed sole British agents for the well-known Ward-Leonard apparatus, including motor starting and controlling switches, circuit breakers, theatre dimmers, &c., of which a large stock will be kept in hand.

We are informed that Messrs. Welch, Fry, & Skelton have removed from 90, London Wall, owing to the premises being pulled down, and have taken new and convenient premises at Salisbury House, in the same thoroughfare.

Messrs. Ward & Goldstone inform us that they have taken larger premises at 45, Doulton Street, Manchester, where they are making cables.

ELECTRIC LIGHT AND POWER NOTES.

Abersychon (Mon.).—Owing to a difference between the Gas Company and the District Council, it is highly probable that the latter will shortly take up the question of electric lighting.

Ballarat.—The British Insulated Wire Company has formed in Ballarat a branch company to be called the Electric Supply Company of Victoria, which will carry on the business of electric lighting in other centres, such as Bendigo and Eaglehawk. The company will guarantee the local company to any necessary extent. In Ballarat the company, which will soon take over the local electric lighting works and tramways, is about to spend between £60,000 and £70,000. The City Council has agreed to surrender the order now held by the Council and to consent to the Electric Supply Company of Victoria obtaining a new delegation.

Basingstoke.—The electric lighting provisional order of the Town Council has received the Royal assent.

Belfast.—The engineer's summary of the electricity accounts for the six months ended June 30th, 1900, shows 351,641 units sold for the half-year, as against 244,589 for the corresponding period of last year, equal to an increase of 44 per cent., the current sold for motor purposes being 15 per cent. of the total, or an increase of 85 per cent. over the motor current sold during the corresponding period of last year. This is, no doubt, largely due to the facilities which the committee has given for the hiring out of motors.

Bradford.—Mr. G. W. Wilcocks, Local Government Board inspector, held an inquiry last week into the application of the City Corporation for powers to borrow £56,315 for electric lighting purposes. Mr. Chattock, electrical engineer, explained the plans to the inspector, and the inquiry then closed.

Bridgwater.—At the last monthly meeting the Corporation received the report of Mr. W. H. Trentham, their consulting electrical engineer, on 64 tenders for the equipment of the electricity works, and accepted tenders to the value of £14,778. The Corporation also decided to apply to the Local Government Board for sanction to borrow £20,000. The opponents of the scheme referred to the tenders exceeding the original estimate by £4,000 odd, but the chairman of the committee pointed out that since the estimate was prepared it had been decided to introduce 120-KW. machines instead of 90, which accounts for a large proportion of the difference.

Chichester.—The City Council's provisional order having expired on the 1st inst., the Council has referred the question of electric lighting to a committee, but displays little intention of pressing the matter forward. Meanwhile, a company has notified its intention of applying for an order.

Christchurch.—The Board of Guardians has instructed Mr. Peers to prepare plans and specifications for electric lighting, on which tenders might be obtained, on the following terms, viz., 40 guineas if the Guardians do not proceed with the work, and if they do proceed the above charge to be included in 5 per cent. remuneration on the outlay.

Cowes.—The District Council has resolved to apply to the Board of Trade for an extension for seven years of its provisional order, with a view to carrying out an electric lighting scheme.

Epsom.—Owing to the increase in the rate of interest on loans from 2¾ to 3¼ per cent., in the price of coal from 16s. to 31s. per ton, the price of water from 6d. to 1s. per 1,000 gallons, and the cost of the buildings, which is £2,000 in excess of the estimates, the District Council has requested Mr. Hawtayne to draw up a revised scheme for the electricity undertaking.

Hertfordshire.—At the meeting of the Herts County Council last week, the Parliamentary Committee presented an exhaustive report dealing with "the North Metropolitan Electric Power Supply Bill, 1900," and recommended that the Council proceed with its opposition. The Council adopted the recommendation.

Friern Barnet.—The District Council has resolved that the necessary steps be taken to procure a provisional order for the electric lighting of the district.

Germany.—The central station which Messrs. Siemens and Halske, of Berlin, have contracted to establish in the town of Kiel will at first comprise two 400-H.P. steam dynamos and a battery of accumulators of a capacity equal to 300 H.P.

Glasgow.—The accounts and balance-sheet of the Corporation Electricity Department for the year ended May 31st, state that the revenue for the year amounted to £59,762, of which £55,471 was from the sale of current per meter, and £4,291 from the Lighting Department for lighting the streets. Last year the revenue from these respective sources was £41,639 and £2,502, making a total of £44,141, the increase thus being £15,621. The expenditure for the year was £35,000, to which was added the sum of £3,182, making a total of £38,181, leaving a balance of £21,581 to be carried to profit and loss account. Last year the expenditure was £31,534, the amount set apart for depreciation £7,521, and to profit and loss account, £12,607. The borrowing powers sanctioned by the Secretary for Scotland amount to £700,000, and £628,500 has been borrowed at 3¼ per cent. Of this amount £11,500 has been repaid, leaving borrowing powers to be executed to the amount of £60,000. The total amount of electricity generated last year was 3,401,731 Board of Trade units, against 2,619,019 in the previous year. The amount supplied to private consumers last year was 2,566,016 units, as against 1,885,902 units in the previous year, an increase of 680,114 units, while for public lamps the quantity supplied last year was 258,334, an increase of 30,200.

A slight explosion of gas took place in a manhole in connection with the electric lighting system at the corner of Queen Street and St. Vincent Place on Wednesday last week. The cover was blown off, but fortunately no one was injured.

Leatherhead.—The Board of Trade will not sanction the proposed leasing of the District Council's provisional order to a firm of electrical engineers, stating that there must be an actual transfer of powers. The whole question has therefore gone back to Committee again.

London.—Hampstead.—The Vestry has appointed Mr. A. E. Cramb, of Huddersfield Corporation electricity works, to the post of assistant electrical engineer.

Plumstead.—The Vestry has resolved to apply to the London County Council for its sanction to a preliminary loan of £20,000 for an electric light station, dust destructor, &c.

Barnes.—The District Council has received the sanction of the Local Government Board to its proposed loan of £30,963 for electric lighting.

London Electric Lighting Companies and the Board of Trade.—On Tuesday, according to the *Times*, the President of the Board of Trade received a deputation from eight London electric lighting companies, who desired to have the Board of Trade regulation as to the supply of electricity amended so that they could change from 100 volts to 200 volts by agreement with the consumer, or, failing agreement, by arbitration. The regulation at present says that no change shall be made in the pressure of the supply to any premises except with the consent of the consumer. Mr. Ritchie was accompanied by Sir Courtenay Boyle, the Hon. T. H. W. Pelham, Mr. Garnham Roper, and Mr. A. P. Trotter. The deputation was headed by Lord Suffield, and consisted of the representatives of the following companies:—The Westminster, the Metropolitan, the Chelsea, the City of London, the County of London and Brush Provincial, the Notting Hill, the Brompton and Kensington, and the Kensington and Knightsbridge.

Prof. Kennedy said the Westminster Company was the first to change over from 100 volts to 200 volts, and all the other London companies present were in various stages of changing over. An infinitesimal number of consumers could prevent the change so long as this Board of Trade regulation remained in its present form. They suggested that, instead of the change from 100 volts to 200 volts being made with the consent of the consumer, it should be settled by an arbitrator appointed by the Board of Trade.

Mr. Ritchie, in reply, said perhaps this difficulty could have been avoided if the companies had adopted a more conciliatory tone to the consumers when they desired to make the change. The consumers at present had the right to refuse, and they might *bona fide* consider that there was danger in raising the voltage from 100 to 200 volts. Certainly they ought not to be told that their supply would be cut off if they did not accede to the change.

General Webber, on behalf of the electric companies, said it was their last wish to use threats, even resembling those sent out by the gas companies. It was in the interest of the public in London that the voltage generally should be raised from 100 to 200 volts.

Mr. Ritchie admitted that it was a strong order for a few people to stand in the way of the application of the new system, but these people were within their rights, and if the Board assented to the proposal of the companies they would be over-riding the rights which these people possessed. The companies could not refuse to supply any consumer with 100 volts if he desired to have it. He would take the matter into consideration, but he hoped the companies would use more conciliatory methods with their customers.

The deputation, having thanked Mr. Ritchie, withdrew.

Marylebone.—Last week at a meeting of the Marylebone Vestry the special Electric Lighting Committee submitted a report as to the successful opposing of the Marylebone Electric Supply Company's provisional order, and recommended that the Vestry empower the committee to conclude negotiations with the Metropolitan Electric Supply Company for the transfer of its undertaking to the Vestry. The matter was adjourned for further consideration.

Hornsey.—Following on the resolution of the District Council to carry out Mr. Hammond's scheme for electric lighting, involving an expenditure of £73,000, the Council, on Monday, appointed Mr. Hammond as consulting engineer.

London County Council.—The Council at the meeting on Tuesday resolved to lend £14,000 to the Battersea Vestry for electric lighting purposes, and £30,000 to the Shoreditch Vestry for similar works.

Maidstone.—The District Council has adopted a resolution in favour of municipal electricity supply for the district.

Mansfield.—In a recent issue we reported that the Light Railways Commissioners had granted powers for an electric tramway to serve Mansfield and district, one of the conditions being that the tramway company should obtain its supply of electrical energy from the Corporation. As a first step towards laying down works, the Council, on Friday last, unanimously appointed Mr. R. Hammond their consulting engineer.

Monmouth.—Mr. E. A. S. Faucett held a Local Government Board inquiry on Thursday last week respecting an application made by the Corporation for power to borrow £28,000 as a supplementary loan for the purpose of completing the combined scheme for drainage and electric light in the borough. The original estimate was for £20,000, and a loan of that amount had been obtained. The Corporation had since borrowed some £9,000 from a local bank, and wanted to borrow £28,000 to repay the bank and complete the work. There was no direct opposition to the loan, but a good deal of dissatisfaction was expressed. The ex-mayor (Colonel Walwyn) in the course of a heated address to the Commissioner, said the Corporation had been entirely and disastrously misled by their engineer. The Commissioner promised to obtain from Messrs. Bramwell and Harris an explanation of the large discrepancy between their original estimate for electric lighting and the actual cost. The inquiry then closed.

Newcastle-Emlyn.—A provisional committee has been appointed here from amongst guarantors to consult experts on electricity, &c., with a view of submitting a scheme to the town. The district is well supplied with water-power.

Newbury.—The Corporation, which owns the gas works, has held a provisional order for electric lighting since 1892, but this has expired, and the Board of Trade are pressing for an answer as to the course intended to be pursued. A company has also announced its intention to apply for powers. The Corporation has obtained a report from Mr. H. W. Wilkinson, who advises that the provisional order should not be allowed to lapse, but either disposed of to a company or worked by the Corporation for the benefit of the town, in conjunction with a dust destructor. The report recommends the provision of a plant to supply about 2,500 lamps of 8 C.P. alight at one time, or 4,300 lamps connected, at a cost of about £11,520. The Corporation will meet to consider the report to-night.

Provisional Orders are to be sought for—

Alnwick.—By the Northern Counties Electricity Supply Company, and by the North British Electricity Supply Company.

Britonferry.—By the Electrical Power Distribution Company, Limited.

Buckhurst Hill.—By the County Electricity Supply Association.

Chichester.—By the North British Electricity Supply Company.

Cumnock.—By the North British Electricity Supply Company. The Burgh Commission will not oppose.

Dunfermline.—By Edmundson's Electricity Corporation, Limited, on behalf of the Urban Electric Supply Company, Limited.

Esher.—By the Twickenham and Teddington Electric Supply Company, Limited, and by the United Electric Light and Traction Company, Limited.

Fife.—By the Electrical Supply Company.

Ham.—By the Twickenham and Teddington Electric Supply Company, and by the Richmond (Surrey) Electric Lighting Company.

Hampton.—By the Twickenham and Teddington Electric Supply Company, Limited, and by the Richmond (Surrey) Electric Light and Power Company, Limited. The District Council will oppose, and is taking active steps in the matter of electric lighting.

Inverleithen.—By the North British Electricity Supply Company.

Kingstown.—By Messrs. Porte, Sykes & Co.

Lyndhurst and Colbury.—By the Lyndhurst Electric Lighting and Traction Company, Limited.

Neath.—By the Electrical Power Distribution Company, Limited.

Normanton.—By a syndicate.

Oban.—By the North British Electricity Supply Company. The Town Council has a scheme of its own in hand.

Rushall.—By the Midland Corporation for Power Distribution, Limited.

Shildon.—By the Northern Counties Electric Supply Company.

Sunbury.—By the Twickenham and Teddington Electric Supply Company, Limited.

Teddington.—By the Twickenham and Teddington Electric Supply Company, Limited, and by the Richmond (Surrey) Electric Light and Power Company, Limited.

Tewkesbury.—By the North British Electricity Supply Company.
Wanstead.—By the County Electricity Supply Association.
Warwick.—By the British Electric Traction Company (?)

Pwllheli.—Messrs. Bennett, Ward & Son, of Manchester, are in negotiation with the Town Council for the transfer of the Council's electric lighting provisional order.

Radcliffe.—The District Council has requested Messrs. Lacey, Clirehugh & Sillar to prepare a combined report on the electric lighting and tramway scheme.

Rochdale.—For over eighteen months the Rochdale Corporation has been erecting electricity works which will cost about £30,000, and it is expected that at the latter end of August they will be in a position to supply customers with the current. The works site covers an area of 2,838 square yards, not more than half of which is at present in use. In the engine room there are two 275-H.P. engines, which are supplied with steam by two 30 feet by 8 feet boilers fitted with mechanical stokers; there is ample space for extensions. The dynamos are designed to generate at 440 volts for supply to the town, and 500 volts for traction purposes, it being the intention of the Corporation to purchase the tramways, and to substitute electricity for the present steam haulage. The system adopted is the low-tension three-wire system, supplied with current from distributing stations. The prices to be charged for energy are 3d. per unit for power, and 6d. per unit for lighting purposes. Mr. T. A. Lacey, the Corporation electrical engineer, has superintended the erection of the works and the putting down of the plant.

Stourbridge.—The Destructor and Electric Powers Committee at Stourbridge have decided to report unanimously in favour of the Council retaining its provisional order in its own hands, and also that steps should be taken at once to lay down a plant sufficient to supply the present needs of Stourbridge.

Uxbridge.—The District Council received an application from the Northwood Electric Lighting Company at their last meeting asking that the Council's assent be given to the granting of a provisional order. A communication was also read from the Parish Council of Ruislip recommending the District Council of Uxbridge to give the application their favourable consideration. The assent was given unanimously.

Wolsingham.—At the suggestion of the Weardale District Council, the directors of the Stanners Closes Steelworks are considering the advisability of lighting the town of Wolsingham with electricity.

Watford.—Some members of the District Council having adversely criticised the Babcock & Wilcox boilers in the electricity works, that firm has addressed a letter to the Council protesting against the remarks that were made, and offering to guarantee their boilers for a considerable term. Independent expert opinion is to be obtained.

Willesden.—The District Council on Tuesday last unanimously adopted the scheme drawn up by the Council's electrical engineer, Mr. Ruthven Murray. A mixed system is to be adopted—low pressure direct current for the central parts of the area supplied, and three-phase alternating current at high pressure for the more distant parts, the district being very large and scattered. To avoid undue expenditure, two multipolar double current machines are to be installed, giving direct or alternating current as desired, and two alternate current generators. The total capacity of the plant will be about 40,000 lamps connected at the commencement. It is proposed, also, to carry out a system of electric tramways. Mr. Manville has reported favourably on Mr. Ruthven Murray's scheme, which he considers to be well adapted to the conditions obtaining.

Worksop.—An inquiry was held last week by Colonel W. Langton Coke, inspector of the Local Government Board, relative to the District Council's application for leave to borrow £15,779 for electricity supply purposes. The estimated population of the town is 14,000, annual rateable value £49,469, and the outstanding balance on loans £21,443. The Council proposed to arrange for the new loan of £15,779 to extend over a period of 30 years. The project was supported by the agent to the Duke of Newcastle, who represented £3,000 worth of rateable property in the town. The engineer for the installation is Mr. A. B. Mountain, M.I.E.E, of Huddersfield, who estimated the net profit available for the relief of the rates or reserve at the end of the second year's working at £407. The Council was unanimous, and there was no opposition.

ELECTRIC TRACTION NOTES.

Adelaide.—With reference to the Adelaide electric tramways, it is stated that a strong syndicate has been formed for the purpose of dealing with the concession lately obtained by Mr. W. G. Bingham from the Corporation of Adelaide, and that the necessary capital of over a million sterling has been guaranteed.

Bermondsey.—The London County Council last week informed the Vestry that they intended to apply in the next session of Parliament for powers to construct tramways for a conduit system of electrical traction along the new Tower Bridge southern approach now in course of construction, under powers obtained in 1895, between Bermondsey New Road and Tooley Street.

Bournemouth.—The report by Messrs. Lacey, Clirehugh and Sillar, the consulting engineers appointed by the Bournemouth Corporation, and of Mr. F. W. Lacey, the borough surveyor, on the new tramway scheme has been approved by the Tramway Subcommittee, and was adopted at the Town Council meeting on the 19th inst. It was stated that the Corporation's provisional order empowered it to construct tramways within the borough, but that the Poole and District Electric Traction Company had also a Bill in Parliament, which would doubtless pass, giving them power to make a line over one of the main roads in the borough from Boscombe to the Lansdowne if the Corporation did not do so within two years. It was therefore necessary that no time should be lost to secure that route for the Council. In addition to this, both the company and the Corporation had secured power to run over each other's lines, the company having to construct lines from Christchurch to the county borough boundary on the east and from Poole to the boundary on the west, and the Corporation to connect the two points. Looking at the vast traffic to be carried, it was felt desirable that the system should be one of double lines running side by side for the main distance, but diverging in several parts of the town where the roads were narrow, and going different routes. The gauge of the lines would be 3 feet 6 inches. The overhead electric system of traction had been advised as the most suitable and cheapest, and it was also proposed to utilise the poles for electric lamps along the line of route to replace the present gas lighting. The total cost of the system was estimated at £166,485, and the street lighting at £11,640. The cost of the underground conduit system would have been £258,665, or half as much again. The receipts were estimated at £44,000 a year, the annual charges at £31,900, leaving a profit of £12,000 a year to the ratepayers. The Corporation are also acquiring a site alongside the L. and S.W. Railway near Bournemouth Central for a generating station.

Buenos Ayres.—The owners of the electricity works at San Fernando, Messrs. Valera, Cuneo Hermanos & Co., have obtained a concession from the authorities of Buenos Ayres for an electric tramway between that city and Martinez, San Isidro, and San Fernando.

Bury.—The Council have instructed Messrs. Lacey, Clirehugh & Sillar to prepare a report on the electric tramway scheme.

Darlaston.—A trolley wire was broken, it is said, by lightning last week, and fell on a horse, which was knocked down by the shock, throwing the occupants of the vehicle attached to it into the street.

Dudley.—A sad accident took place last week, when a child, four years old, running across the road, was killed by an electric car which was descending a hill.

Italy.—La Società Elettrica Alta Italia has contracted to convert the accumulator tramway in Turin to the overhead conductor system.

London.—An important report dealing with a proposal to construct a tramway extending along the Embankment from Blackfriars to Putney Bridge will be submitted to the Chelsea Vestry for consideration at the next meeting. A scheme by which trams would be run by way of the Victoria Embankment, Victoria Street, Buckingham Palace Road, and the Chelsea Embankment to Putney has been approved by the Improvements Committee of the London County Council, subject to the local authorities in control of the various municipal areas through which the line will pass agreeing to contribute between them a third of the cost.

London County Council.—At the meeting on Tuesday, the Highways Committee reported that the British Westinghouse Company had offered to sell for £900 the electric car complete with motors, controller, and electro-magnetic brake, shown by the company at the recent Tramways Exhibition. It appeared that Prof. Kennedy and the tramways manager were both of opinion that the offer should be accepted, as the car would, with some modifications of detail, be available for working on the Council's lines when reconstructed for electric traction; and, moreover, it would be useful to have a car of this type thoroughly examined, when the specifications for the construction of the cars for use on the electrically equipped tramways were in preparation. The company had further offered to sell to the Council, for the sum of £175, the running rails complete, shown with the car, but stated that that sum did not in any way represent the actual cost of the material, and would little more than cover the cost of transferring the rails, &c., from the hall to the Camberwell tramway depôt. The company made it a condition of the sale that it should be permitted to supervise the installation of the piece of permanent way, charging to the Council only the actual out-of-pocket expenses for labour, concrete, paving materials, &c. The company had further offered to furnish at its own cost, for two or three weeks, the services of one of its own motormen, so that some of the Council's employés could be instructed in the driving of the car and the working of the brake. The tramway manager was of opinion that the offer should be accepted with regard to the labour in connection with the fitting up of the permanent way, but he stated that the concrete and paving could be done by the Council's own staff with materials now in hand. The manager stated that there was room at the Camberwell depôt for the laying down of the permanent way and for the proper housing of the car; and that the expenditure for this piece of line would by no means be money thrown away, as it could be used for depôt work, and at the

price, would be a very profitable investment. With regard to the power necessary to run the car, the company had offered to lend to the Council for six months, for the sum of £75, a gas engine and dynamo for the operation of the line. Having given full consideration to the matter, the Committee were decidedly of opinion that the offers of the company should be accepted, as the car and rails would be of value in affording members of the Council the means of seeing for themselves the system of electric traction to be adopted on the Council's lines, when reconstructed under the powers sought by the Bill now before Parliament. The Council, on the recommendation of the Committee, decided to accept the company's proposals.

In compliance with standing orders the Council postponed until next week the consideration of proposals by the Highways Committee in the direction of 28 new tramlines to be promoted in the next session of Parliament. The following are extracts from the lengthy report on the subject:—

"Our proposals are for the construction of new tramways of a total length of about 16¼ miles on the *north* side of the Thames, at an estimated cost, for the tramways and necessary paving and other works in connection therewith, of about £469,700, and for street-widenings of about £544,360; while, as regards the *south* side of the Thames, the total length of tramways is about 12 miles, the cost of construction and paving works is estimated at about £374,500, and of the street-widenings at about £449,400. As regards the street-widenings, we have been in consultation with the Improvements Committee; and we understand that it proposes to recommend (*a*) that the Council do contribute, out of the funds applicable to improvements, sums amounting in the aggregate to £355,005, and (*b*) that the road authorities concerned shall contribute sums amounting in all to £326,688. The remainder of the cost of the street-widenings, £312,037, we propose shall be charged to the tramways account, as part of the first cost of the several tramways."

"We propose that those of the new lines which will be intimately connected with the Council's (northern) tramways (leased until midsummer, 1910, to the North Metropolitan Tramways Company), shall, with one exception, be constructed for horse traction, unless in the meantime, effect shall have been given to the provisions in the company's lease relating to the conversion of the system from horse to electrical traction. The estimates provide, however, for rails of sufficient weight to permit of their being used for electrical traction when that system shall have been adopted on these tramways. The exception is the tramway in the Archway Road, which will practically be an extension from the Council's tramway terminus in that road to the county boundary, and will probably be joined with the light railways which the Middlesex County Council is seeking powers to construct from that point to Finchley and beyond. As the Middlesex Council proposes to adopt a system of electric traction for its light railways, we think it expedient that the Council's new Archway Road line should be constructed for a similar system of traction. Those of the new lines which will be intimately connected with the London County Council tramways undertaking, or which being for the present detached from either undertaking, could be worked by the Council independently of any other system of tramways, we propose shall be constructed for some system of electrical traction."

The Works Committee of the Chelsea Vestry has passed a resolution adverse to the County Council's tramway scheme.

The Brompton and Piccadilly Circus Railway Bill, which proposed, among other things, to extend the time for the compulsory purchase of lands and the completion of the undertaking, is not to be further proceeded with this session.

Lancaster.—When the Lancaster Corporation approached the Lancaster and District Tramway Company with the object of purchasing their line to Morecambe they were unable to come to terms, and general regret was expressed that the proposed electric tramway had to be abandoned. Another scheme is, however, coming to the fore, and a company intends seeking powers to construct an electric tramway from a point within the Borough of Lancaster to the west end of Morecambe, the terminus suggested being near the West End Pier. If the line could be laid "as the crow flies," the journey could be done in a quarter of an hour, but the land between the west end of Morecambe and Lancaster is affected by the tidal river, and probably the surveyors and engineers would deem it necessary to make a detour. One point against a company scheme is the fact that the Lancaster Corporation has just obtained Parliamentary powers to construct electric tramways in the borough, and it is not likely that it would care for its monopoly being interfered with. The Corporation may therefore decide along with the Morecambe Urban District Council, which is, by-the-way, asking for corporate powers, to construct the tram line in question themselves. The west end of Morecambe adjoins Heysham, which will undoubtedly become an important harbour as soon as the Midland Railway Company complete their scheme.

Liverpool.—Rapid progress is being made with the conversion of the tramways. An important section—to the Pierhead—was completed last week, and traffic commenced, extensive alterations being made in the routes followed by the cars in consequence of the change.

An empty car caught fire while running on the Overhead Electric Railway last week, and was burnt out.

Maidstone.—At a special meeting of the Town Council on Monday it was resolved that application be made to the Board of Trade for a provisional order for the construction of electric tramways in the borough. There was some opposition, based on the fact that the Council has not yet received authority to borrow a loan of £34,000 for electric lighting, concerning which an inquiry was held three months ago. The townspeople, however, are almost unanimously in favour of tramways.

Manchester.—At a meeting of the Tramways Committee of the Manchester Corporation on Monday, it was reported that an agreement had been arrived at as to the working of the electric tramways in Withington and Moss Side. The terms of the agreement with each authority were confirmed by the Committee, and will in due course be submitted to the City Council. With the exception of Salford, arrangements have now been made with every local authority concerned, and it is probable that an amicable settlement will before long be made with the Salford Tramways Committee. At the same meeting the committee adopted a design for the centre poles which will carry the wires. Mr. Wordingham, electrical engineer to the Manchester Corporation, is the designer. Three kinds of seats have also been adopted for use on the top of the cars. In two cases the seat can by a roller-like movement be reversed whenever it is wet, whilst the other is of a close wire netting through which the rain will readily find its way.

Newport (Mon.).—The Corporation has accepted the tender of Messrs. A. Krauss & Son, Bristol, for the erection of the new electric tramway on Corporation Road, but a special meeting of the Council has been called for to-day to reconsider the question of the tenders in consequence of the inability of Messrs. Krauss and Son to procure delivery for four months of certain material.

Paris.—A section of the underground electric railway, from Vincennes to the Porte Maillot, was opened last Friday. There are seven intermediate stations, one of which is in the Champs Elysées, one of the entrances of the Exhibition.

Southampton.—The electrical engineer, Mr. F. H. Chaplin, has reported on some stoppages which took place on the tramways in May and June. One of these was due to a breakdown in a feeder cable, but most were caused by defects in the trolley poles, which are to be replaced by stronger ones. No defect has been found in the generating station.

Surrey.—The County Council last week discussed the pending application of the British Electric Traction Company, Limited, to the Light Railway Commissioners for an order authorising the construction of light electric railways in the borough of Kingston, and in the urban districts of Surbiton, Esher, the Dittons, the Maldens and Coombe. It was decided to oppose the application so far as was necessary to protect all county interests.

Wrexham.—Last week a special meeting of the General Purposes Committee of the Wrexham Town Council was held to consider a notice served by the Drake & Gorham Electric Company, applying to the Board of Trade for an extension of 12 months from August 1st next for the commencement of the laying down of electric tramways in Wrexham, and the completion until August 1st, 1902. Considerable discussion ensued, and the committee finally agreed to refrain from objecting to the application for an extension, but at the same time strongly objected to the length of time asked for, and stated that any further extension would be most strenuously opposed.

TELEGRAPH AND TELEPHONE NOTES.

Aberdeen.—At a recent meeting of the Finance Committee of Aberdeen Town Council Mr. Smith, Glasgow, one of the directors of the National Telephone Company, was present, and made a statement in regard to the question of the company being granted wayleave to lay down underground wires. He stated that the expenditure necessary to lay down an underground system would amount to between £35,000 and £40,000, and he gave the assurance that the company would undertake that expenditure without increasing the present charge for telephone service. Besides, the company would promise a large extension of the low tariff system. Mr. Smith was thanked for his statement, and consideration of the whole subject was deferred.

Imperial Telegraphs.—In the House of Commons on Monday last Sir E. Sassoon asked the Secretary of the Treasury whether he would state to the House the composition of the departmental committee on the system of cable telegraphs of the Empire, the scope, and the terms of its reference.

In reply, Mr. Hanbury said: The terms of reference are:—"To inquire into the present system of telegraphic communication between different parts of the Empire and to consider in what respects it requires to be supplemented. To investigate the relations between private cable companies and the Imperial and Colonial Governments (including the Government of India), the amount of control at present exercised by those Governments, and the policy which should be pursued by them in future, especially when new concessions are sought. To examine existing rates, to report how far they are fair and reasonable, and, if not, how any reduction should be effected." The committee will consist of Lord Balfour of Burleigh, as chairman, representing the Board of Trade, the Postmaster-General, the Secretary of the Treasury, the Under-Secretaries for India and the Colonies, and two members from the Intelligence branches of the Admiralty and the War Office.

Mr. MacNeill: Will the right hon. gentleman undertake to supplement the committee by adding two gentlemen of common-sense?

Huddersfield.—The Town Council last week considered the matter of a municipal telephone system, estimated to cost £30,000, and passed a resolution to the effect that application be made to the Postmaster-General for a 25 years' license, and that a municipal exchange be established in the town.

Portsmouth.—The Financial Committee of the Town Council have had an interview with Mr. Bennett, telephone engineer, who stated that an exchange could be established in this borough at a cost of £20 per subscriber, and that, assuming that 500 subscribers were secured, a service could be offered them at the following rates:—An unlimited service, £5 5s.; a £3 10s. service, with a charge of a halfpenny for the first 1,000 messages; or a £2 10s. service, with a charge of 1d. for the first 500 messages. A capital expenditure of £10,000 would also include the provision of 500 surplus wires, so that as more subscribers were enrolled the charges could be reduced. If the co-operation of Gosport, Fareham, Havant, and other contiguous places could be secured, they would be included in the license. After an inspection of the town, Mr. Bennett was distinctly of opinion that it presents no special difficulties. The Finance Committee have instructed him to prepare two schemes—one for an exchange with 500 subscribers and 500 surplus wires, and the other for 1,000 subscribers with 1,000 surplus wires. The matter will be discussed at an early meeting of the Town Council.

Sydney.—The many complaints here about the telephone shortcomings have led to Mr. Watt, Postmaster-General, considering the advisableness of recommending the Cabinet that in any future loans £250,000 shall be raised for the improvement of the telephone service. It is also probable that he will ask for a further sum to increase the accommodation at the post-office in accordance with the original design. Placing the telephone and telegraphic lines underground and the establishment of a complete metallic circuit are among the suggested improvements.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired
South American:—		
Cayenne-Pinheiro	Oct. 11, 1899	..
Cayenne-Paramaribo	Feb. 16, 1900	..
Pará-Maranham	March 1, 1900	July 19, 1900
Ceará-Maranham	Feb. 20, 1900	..
West Indies:—		
Jamaica-Colon	June 30, 1899	..
Mole St. Nicholas-Cape Haitien	March 6, 1900	..
Latakia-Cyprus	June 20, 1900	..
Tarifa-Tangier	Jan. 8, 1900	..
Landlines:—		
Chinese:—		
Tientsin-Pekin	June 12, 1900	..
Pekin-Kalgan	June 14, 1900	..
Kalgan-Maimatchin	June 30, 1900	..
Tientsin, *via* Shanghai	June 16, 1900	..
Tientsin-Niuchwang	June 18, 1900	..
South American:—		
Communications with all offices of Columbia beyond Buenaventura	January 23, 1900	..
Ecuador landlines	March 13, 1897	..
Landlines south of Macahé (Brazil)	April 25, 1900	..
Communication "*via* Hanekine" interrupted on Persian territory	Feb. 24, 1900	..

Telephone Delays.—Under the above heading the *Daily Mail* sets forth the iniquities of the Post Office with regard to the working of the telephone trunk lines, and gives the following list of some of the worst cases of delay in June last:—

	hr.	min.
Sunderland and Glasgow	2	10
London and Newcastle	2	10
Newcastle and Leeds	2	0
Greatham and Sheffield	2	16
West Hartlepool and Bradford	2	46
Yarmouth and Kingston	2	10
Yarmouth and Boston	2	6
London and Newport	2	6½
London and Glasgow	2	3
Rotherham and Birmingham	2	10
Workington and Newcastle	1	37
Kendal and Coventry	1	48
Blackpool and Manchester	1	51

Wireless Telegraphy.—Writing to the *Times* of the 18th inst., Major Flood Page, managing director of Marconi's Wireless Telegraph Company, Limited, discusses Mr. Ritchie's statement on communication with lightships and other matters, and cites an installation at Borkum which is being worked by German Government telegraphists on a commercial footing. The Post Office authorities, as long ago as May, last year, were considering the question of licensing the company in respect of telegraphic communication between ship and shore, but have apparently stopped at that stage. Major Flood Page consoles himself with the hope of obtaining a license *some* day, and with the excellent results obtained with the Marconi system on warships in Delagoa Bay; the Admiralty, moreover, has arranged with the company to instal the apparatus in more than 30 ships and torpedo stations.

CONTRACTS OPEN AND CLOSED.

OPEN.

Aarhus, Denmark.—The municipal electrical works are wanting "200 pieces electro-meters." For particulars see "Official Notices" July 20th.

Belfast.—August 15th. The Electric Committee wants tenders for an auxiliary feed-water heater and piping. See "Official Notices" to-day.

Blackburn.—August 6th. The Corporation wants tenders for a traction switchboard. See "Official Notices" to-day.

Bradford.—August 13th. The Guardians of the Bradford Union want tenders for the electric lighting of the workhouse.

Brussels.—September 19th. The Council of St. Jilles, lez Bruxelles, invites tenders for the installation and the commencement of supply upon a part of its territory. Conditions and plan for three francs at the office, No. 14, Parvis St. Jilles, St. Jilles.

Darlington.—July 28th. The Corporation wants tenders for arc lamp-posts and brackets. See "Official Notices" July 13th.

Dorking.—The District Council are open to receive offers for leasing their provisional order. See "Official Notices" July 20th.

Germany.—July 28th. Tenders are being invited until the 28th inst. by the State river authorities at Emden for the supply and erection of three 1½-ton electric wall cranes, and a 40-ton electric swing crane. Tenders to be sent to Die Königliche Wasserbauinsfertion, Emden, Germany, whence particulars may be obtained for 2s.

Grays Thurrock.—August 9th. The Council is inviting tenders for Lancashire boilers, 100-kw. steam dynamos, economisers, switchboards, battery, crane, mains, and other plant, &c. See "Official Notices" June 29th.

Grimsby.—August 8th. The Corporation wants tenders for wiring the electricity works. See "Official Notices" July 20th.

Halifax.—July 31st. The Corporation wants tenders for a steam engine and alternator, alternators, static transformers, induction motors, rotary converters, and three-phase extra high tension switchboard. See "Official Notices" July 13th.

Halifax.—Tenders are invited by the Town Council for mechanical stokers. See "Official Notices" to-day.

London.—August 20th. The Central Electric Supply Company wants tenders for boilers and piping, and mechanical stokers. See "Official Notices" to-day.

Madrid.—August 18th. Tenders are invited by the Spanish Government, not later than August 18th, for the concession of a system of electric tramway lines in Barcelona. Some particulars may be examined at the commercial department of the Foreign Office between 11 a.m. and 5 p.m.

Russia.—August 28th. The General Direction of the Russian Posts and Telegraphs in St. Petersburg are inviting tenders until August 28th for the concession for the working during a period of 68 years of the telephone exchanges in St. Petersburg, Warsaw, Riga, Moscow, and Odessa.

Salford.—August 13th. The Corporation wants tenders for lighting cables, tramway feeders, and street lighting. See "Official Notices" July 13th.

Spain.—August 10th. Tenders are being invited until August 10th by the municipal authorities of Mogner (Hullva province), for the concession for the electric lighting of the town during a period of 20 years. Particulars can be obtained from, and tenders are to be sent to El Secretario del Ayunlamento de Mogner (Hullva).

Stockport.—August 31st. The Tramways Committee wants tenders for 20 double-deck tramcars with electrical equipments. See "Official Notices" July 13th.

Sunderland.—July 27th. The Corporation wants tenders for a coal conveying plant for the electrical supply station. See "Official Notices" July 13th.

The Pacific Cable.—August 14th. Tenders for the manufacture and laying in the Pacific Ocean of 8,272 nautical miles of telegraph cable are invited by the Pacific Cable Committee on behalf of Her Majesty's Government and the Governments of Canada, New South Wales, Victoria, New Zealand, and Queensland. See "Official Notices" July 20th.

Torquay.—August 6th. Tenders are wanted by the Corporation for two water-tube boilers with superheaters, two inductor alternators with Willans engines, pipework, surface condenser, extensions to high tension switchboards, wattmeters, &c., and transformers. See "Official Notices" July 20th.

Warsaw.—August 28th. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Acting Consul-General at Warsaw stating that tenders are invited by the Russian Government, not later than the 28th prox., for the telephone service of Warsaw, St. Petersburg, Moscow, Odessa, and Riga Some particulars may be examined at the Commercial Department of the Foreign Office between 11 a.m. and 5 p.m.

CLOSED.

Tynemouth.—The Town Council has accepted Messrs. Siemens Bros. & Co.'s tender for arc lamps at about £350.

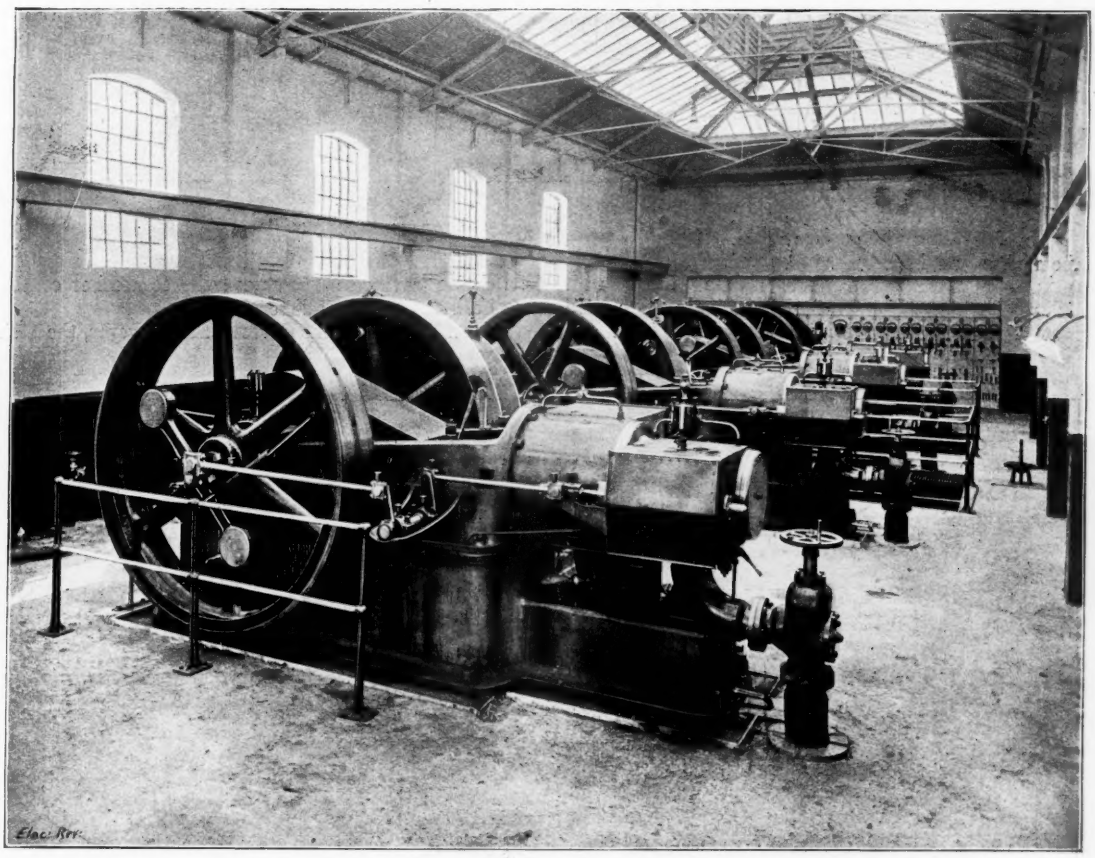
(*Continued on page* 147.)

NORWICH ELECTRIC TRAMWAYS.

Within the last three years the ancient city of Norwich has undergone a remarkable transformation. A typical old English cathedral city, with narrow winding streets, many of which were built in mediæval times, and with a population of 115,000 souls, Norwich possessed not even a horse tramway; yet it has always been an important market town, a cattle trading centre, and the county town of Norfolk.

However, the keen eyes of the enterprising electric tramway engineer were not slow to appreciate the promising field presented by this virgin city for an up-to-date system of rapid transit, and in 1896 two companies appeared upon the scene—the New General Traction Company, and the British Electric Traction Company. After a severe but friendly contest for the support of the City Council, in which the former was successful, plans were drawn up under the direction of the chief engineer of the company, Mr. J. E. Winslow, for a complete network of lines radiating from the centre of the town to the outskirts in all directions. The preparation of these plans involved an enormous amount of labour, for it was found to be impossible to carry the lines through many of the most important streets owing to their being extremely narrow and, in some cases, "as crooked as a ram's horn." The engineers, however, were not to be denied; were the roadways too narrow, they must be widened; were the corners too sharp, they must be rounded off; if a building blocked the way, it must be pulled down. In spite of the difficulties encountered, the whole of the numerous plans and details were completed within three weeks, and a Bill was introduced into Parliament, with the full support of the City Council, providing for the construction and equipment of 19 miles of track, together with compulsory powers for the carrying out of a huge scheme of street improvements. We shall refer to the latter more fully later on, but we may mention here that the cost of these amounted to £110,000, of which the company bore two-fifths.

It was not to be expected that this expenditure could be incurred without a *quid pro quo*; this took the form of a 50 years' concession, giving the company a reasonable prospect of recouping itself for the outlay. The benefit to the City has been immediate and marked; congested thoroughfares have been relieved, new streets constructed, narrow ways widened, obstructions to traffic removed. Moreover, although the cars have not yet commenced regular running, building operations along the routes of the tramways in the suburbs of the town have already actively commenced, thus exemplifying the salutary process of redistribution of the population, from the central areas to the more healthy and less heavily-rented outskirts, which always accompanies the inauguration of an electric tramway system.



General View of Engine Room.

There are many points of more than ordinary interest in connection with this scheme, which we shall now proceed to describe in detail.

The power station is situated in the heart of the town, within a stone's throw of the electric lighting station, Duke Street intervening; the site is conveniently placed on a bend of the River Wensum, which affords facilities for coal and water supply. The station itself is of red brick and

consists of engine and boiler room, economiser room, test room, and coal stores.

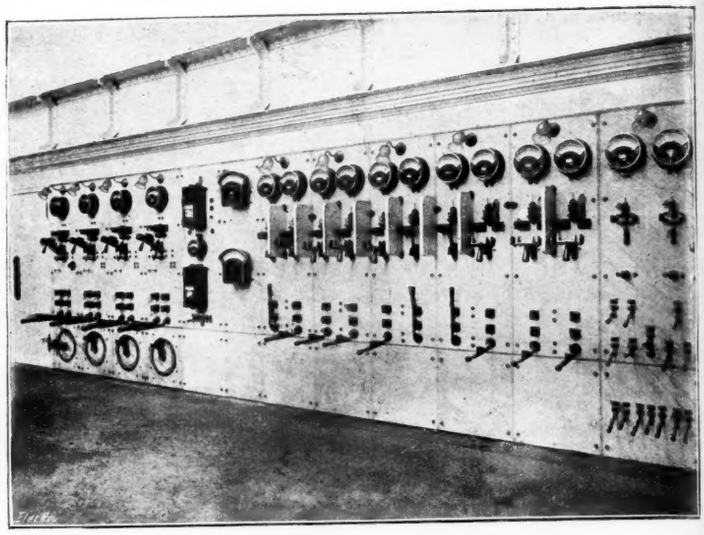
The latter are of simple construction, consisting of cast-iron **H** columns supporting a galvanised iron roof; the back wall is of brick, but the side walls are removable, being built up of a number of wood battens which are dropped into the hollows between the flanges of the girders, as shown by the section below—

By this simple device it is possible to raise or lower the walls as required, to suit the amount of coal in hand. The capacity of the coal store is about 600 tons.

These sheds are situated on the wharf, to which the coal is brought in barges from Yarmouth: an electrically-driven crane raises the coal and deposits it in the stores, whence it is shovelled as required into small trucks. A line of rails runs between the sheds, with suitable turntables, over an Avery dial-reading weighing machine, to a hopper, from which the coal is carried by a Bennis bucket elevator and chain conveyor to the boilers.

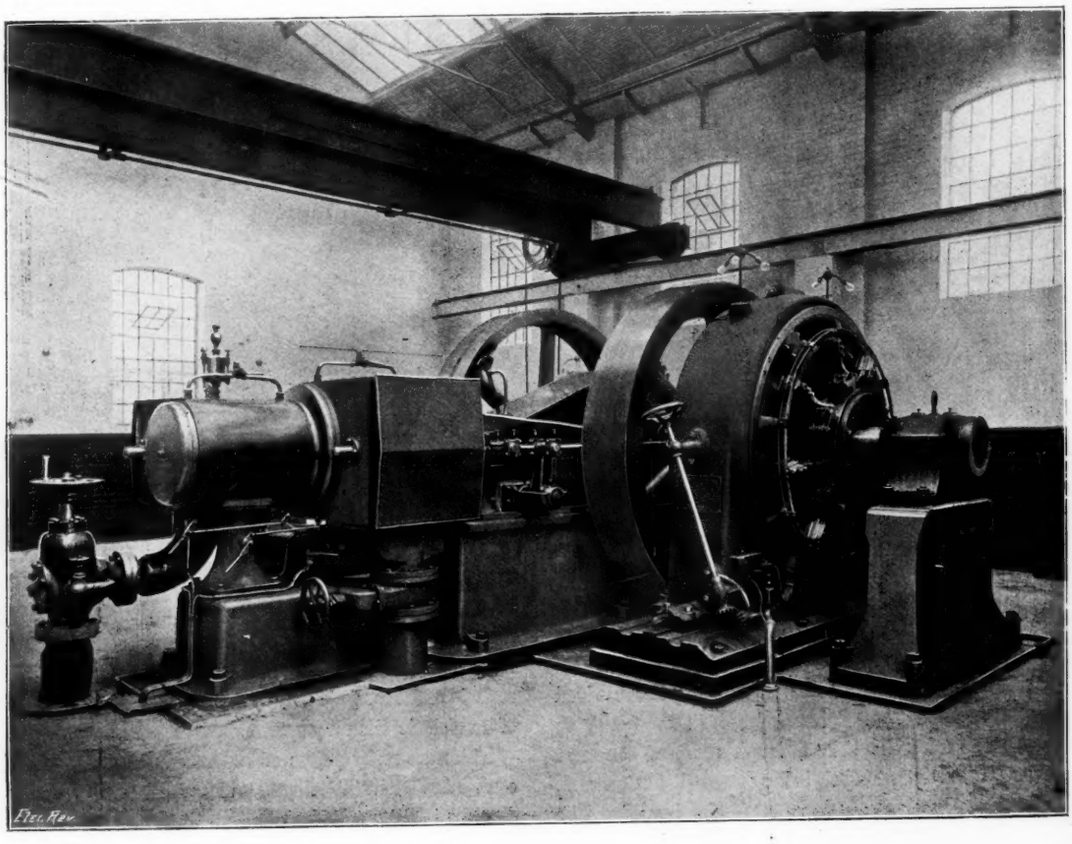
These are four in number, of the Babcock-Wilcox 240 N.H.P. standard size, with double steam drums; each of them has a heating surface of 3,240 square feet. The boilers are fitted with Bennis mechanical stokers of the ordinary type, and work at a pressure of 150 lbs. per square inch. A noteworthy feature in this connection, is the system of automatic regulation; the flue-dampers and the coal handling machinery are controlled by the steam pressure, which is thus kept within 5 lbs. of the normal, almost without attention.

A Green's economiser is provided, and occupies an unusual position, being supported on girders above the boilers, with an obvious saving in floor space; the economiser consists of 480 tubes of the usual dimensions.



Main Switchboard.

Power for driving the elevator and conveyor, the stokers, and the scrapers of the economiser, is furnished by a 10 H.P. Westinghouse motor; as an alternative, these can also be driven by a belt from the fly-wheel pulley

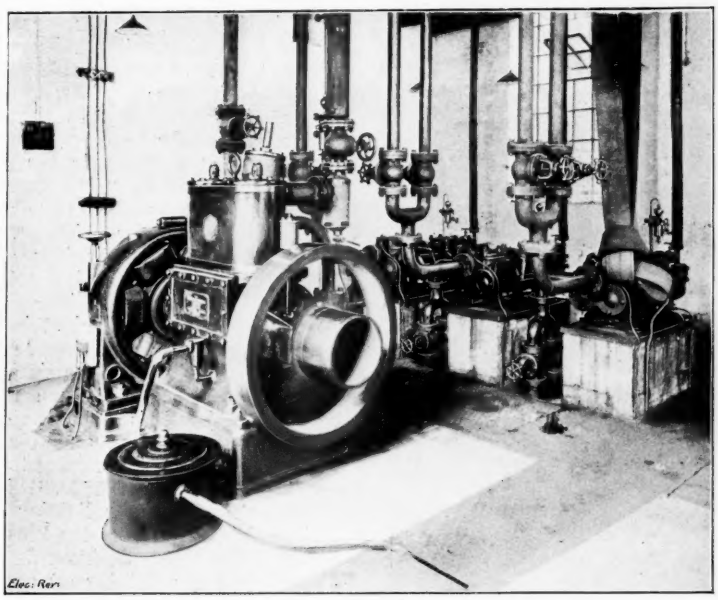


200-kw. Generating Set.

of the steam engine which drives the lighting dynamo.

The chimney is 120 feet high and 8 feet in diameter at the top; the base is square, and stands on a concrete block 25 feet square and 22 feet deep. The bye-pass flue from the boilers enters the square shaft just below the economiser flue.

Feed water is supplied by three Worthington pumps each having steam cylinder 6 inches diameter, and pump barrel 4 inches diameter, with 6 inches stroke, and being capable of delivering 2,500 gallons of water per hour. The feed pipes are arranged in triplicate, drawing from the hot-well, the river, or the city mains, and delivering either through the economiser or direct to the boilers; two oil filters, one of the MacDougal type, the other by Raylton, Campbell and Dixon, are arranged in series with the pumps.

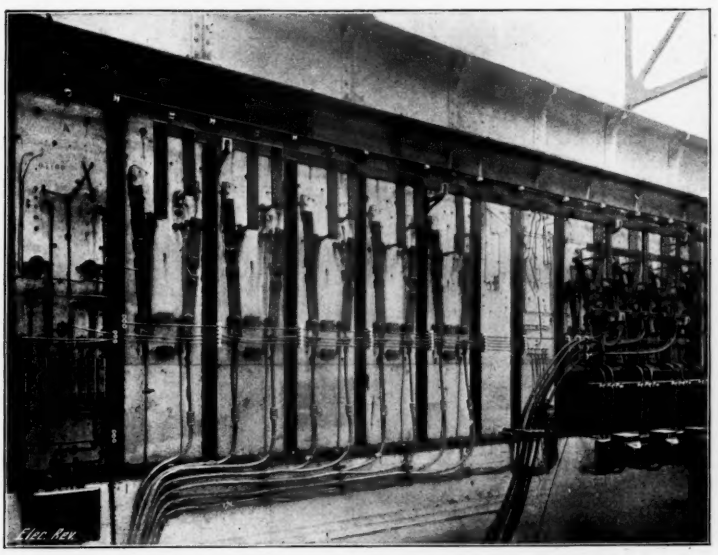


Lighting Set and Feed Pumps.

The steam piping consists of a simple ring, one member of which runs along the back of the boilers, and the other beneath the engine room floor; these are connected by vertical members with slow bends, at the lower end of each of which a main separator is fixed. The pipes are chiefly of steel, but the bends are cast-iron.

The usual costly and heat-wasting array of stop valves is almost entirely absent, being represented only by two valves, one at the middle of each long member: by means of these the ring can be divided into two sections if necessary. The main exhaust pipe, which also runs beneath the engine room floor, is similarly bisected.

The method of fixing the steam pipes is interesting: each of the horizontal members of the range is securely clamped to a bracket near the middle of its length, so that it is free to expand in both directions. These brackets were made the datum points for laying out the whole of the steam piping, which was designed to suit them, no templet pipes being used. The steam pipes are lagged with magnesia sectional covering, and, as well as the exhaust pipes, are carried on rollers. The whole of the steam, exhaust and feed piping was carried out by Messrs. Babcock & Wilcox, who also supplied the valves and boiler fittings. At each end of the exhaust pipe, which extends the whole length of the engine room, there is a Blake and Knowles automatic air valve and a cast-iron up-take.



Back of Switchboard.

There are two sets of jet condensing plant, of the Worthington type, each of which can cope with the steam from two engines at maximum load, or three engines under ordinary working conditions; these are placed between the foundations of the engines, but are visible and readily accessible from the floor level. The air pumps are of the horizontal type, with tandem compound steam cylinders. Condensing water is obtained from the River Wensum.

The engine room is 87 feet long by 33 feet wide and 19 feet high to the eaves; the walls are whitened, and a large part of the roof is glazed, in addition to the windows in the side walls, so that there is abundant light. The iron roof is covered with steel sheeting, 4 inches of coke breeze concrete, and slate, where it is not glazed; the doors are cased in sheet iron, and the floor is of cement, so that the building is as far as possible proof against fire.

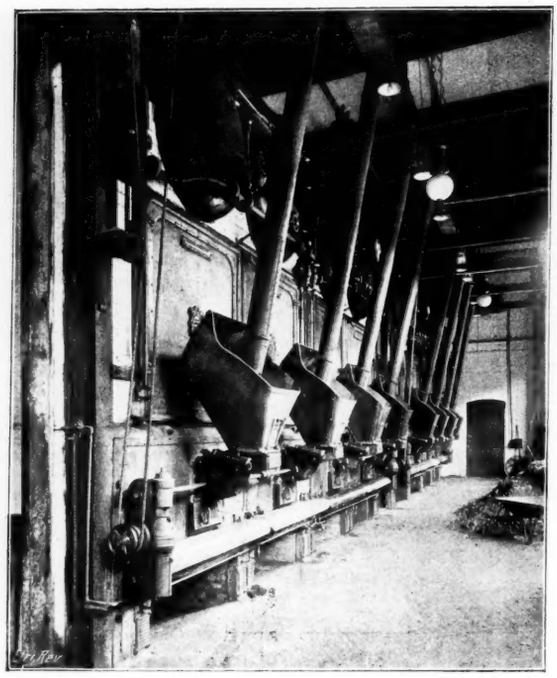
An overhead traveller made by Jessop & Appleby, and capable of lifting 10 tons, traverses the room from end to end.

There are four generating sets, all identical in size, each consisting of a Westinghouse railway generator of 200 KW. capacity, direct driven by a Browett-Lindley horizontal engine: one of our views shows all four from the engine side, while another shows a single set, looking towards the generator.

The engines are of the tandem compound type of 300 H.P., with cylinders 16 inches and 26 inches, and stroke 17 inches. The Begtrup fly-wheel governor is used, acting direct on the high pressure valve, and varying its travel according to the load; the working parts of this governor are very few and substantial, while by reason of its construction it responds immediately to fluctuations of speed. The low pressure slide valve is driven by a separate eccentric with fixed cut-off.

Each engine is provided with two fly-wheels; the heavier of these is mounted on the main shaft between the engine and dynamo, and is split, the two parts being held together by wrought-iron rings shrunk on semi-circular projections at the rim and the hub, together with

bolts. Sight feed lubrication is employed, arranged for continuous running.



Water-Tube Boilers.

The generators are of the standard Westinghouse type, of 200 KW. normal output at 500—550 volts. The field magnet is 8-polar, with separate shunt and series coils on each core, and the yoke is divided in the vertical plane parallel to the armature shaft, so that each half can be drawn outwards on an extension of the bedplate to expose the armature and field magnet windings.

The armature is carried on the main shaft, the outer end of which is supported on a separate pedestal. The bearings are provided with ring lubrication. The core is well ventilated, with toothed periphery, and the winding is of the usual barrel type. The magnetic circuits are electrically balanced by connecting a number of points on the armature windings which are normally at the same potential. This method is found to be so satisfactory in practice, that with the armature running $\frac{1}{8}$ inch out from the geometrical centre of the field, practically no sparking is caused at full load. The brushes are of carbon, the mechanism being carried on a ring fixed to the pole-pieces, so that the commutator end is as free as possible for inspection. The approximate weight of these 200 KW. generators is about 24,400 lbs.

A stand pipe connected with the water supply mains is provided close to each of the bearings for use in case of need to cool them.

The switchboard practically forms the end wall of the engine room, dividing it from the test room; by this means the freest possible access to the back of the board is obtained with a minimum of space occupied. The board is of white marble, and consists of four generator panels, one omnibus panel, one Board of Trade panel, five feeder panels (for 10 feeders), and one lighting panel.

The board is of the Westinghouse Company's make, with the exception of the Board of Trade panel, which is Elliott Brothers.'

The switch gear is all very simple and substantial; plain knife switches are used, and automatic circuit breakers consisting of little more than a double-break switch with carbon break and a solenoid of polished bare copper. The circuit breakers on the generator panels are combined with the equaliser switches. The instruments are of the Weston type, those on the omnibus panel having illuminated dials, and Thomson watt-hour meters are mounted on the back of the generator panels. These are shown in our view of the back of the board, as well as the ammeter shunts and lightning arresters in the feeders. The omnibus ammeter reads up to 3,000 amperes, while each of the generator ammeters reads to 1,000 amperes.

The lighting panel provides for supplying the lighting circuits from either the bus bars or the special lighting set. The latter consists of a 6-pole shunt-wound generator, giving 12 KW. at 500 volts, and driven direct at 390 revolutions per minute by a 7½ inches by 7 inches stroke vertical high-speed engine, the whole set being of the Westinghouse standard type. The engine is of the single-acting type, with two equal cylinders, and a piston valve between them. A small switchboard is also provided close to this set, which, as shown in our view, is situated in the pump room. It is noteworthy that, according to Mr. Winslow's designs, the standard pressure of 500 volts is adhered to throughout the system, whether for lighting or traction. When the main engines are running the lamps are fed from the bus bars, but for about six hours during the night these are stopped, and the lighting set employed. The simplicity obtained by using but one pressure is self-evident.

The car sheds are supplied with current from the trolley wire feeders by two alternative routes, whether the main or the lighting set be used.

Guildhall and Market Place.

Two of the large sets are sufficient to cope with the ordinary load; on holidays, &c., three engines are used, the fourth being always in reserve. The combined efficiency of

the sets is remarkably high, both at full load and at half load; this is a very important feature in tramway working, where the load is constantly varying over a wide range.

(To be concluded.)

CONTRACTS CLOSED.

(*Continued from page* 142.)

Belgium.—On the 16th inst. tenders were opened by the municipal authorities of Jumet (Hainaut) for the establishment and equipment of a central station for the public and private electric lighting of the district. Five firms—all Belgian—competed for the contract, the lowest offer being that of the Société Electricité et Hydraulique, of Charleroi, who quoted 223,650 francs.

Bradford.—The following are the successful contractors in the recent tenders for plant for the electrical undertaking of the Bradford Corporation:—Steam engines, Cole, Marchant & Morley, Limited; 1,000 KW. direct current generators, the British Westinghouse Electric and Manufacturing Company; switchboard, S. Z. de Ferranti, Limited; coal and ash conveying apparatus, Messrs. E. Newell & Co.; steam and feed piping, Babcock & Wilcox, Limited. The acceptance of these tenders is subject to the sanction of the Local Government Board being obtained for the requisite borrowing powers.

Bridgwater.—The following tenders have been received for the electricity works of the Corporation, for which Mr. W. H. Trentham is consulting engineer:—

SECTION A.—BOILERS.

Babcock & Wilcox*	Babcock	£2,850	1 6
Crompton & Co.	Do.	2,383	0 0
Stirling Boiler Co.	Water-tube	2,744	0 0
Tinkers, Limited	Economic	3,567	0 0

SECTION B.—ENGINES.

General Electric Co.	Reavell	2,709	15 0
Thames Iron Works Co.	Reavell	2,905	0 0
General Electric Co.	Willans	2,944	15 0
Suter (Helios)	Alley	2,969	10 0
Lancashire Dynamo Co.	Alley	3,048	0 0
Do.	Browett	3,088	0 0
Parsons*	Parsons	3,092	0 0
Lancashire Dynamo Co.	Willans	3,098	0 0
Thames Electrical Engineering Co.	Allen	3,113	0 0
	Willans	3,185	0 0
Lancashire Dynamo Co.	Belliss	3,308	0 0
Thomas Parker, Limited	Willans	3,355	0 0
Brush Co.	Willans	3,370	10 0
Electric Construction Co.	Reavell	3,382	0 0
Clayton & Co.	Clayton	3,434	0 0
Crompton & Co.	Willans	3,442	0 0
Scott & Mountain	Scott	3,520	0 0
John Fowler & Co.	Reavell	3,537	0 0
British Schuckert Co.	Browett	3,580	0 0
Mather & Platt	Willans	3,583	0 0
Electric Construction Co.	Willans	3,590	0 0
Mather & Platt	Browett	3,613	0 0
W. H. Allen	Allen	3,674	0 0
Electric Construction Co.	Belliss	3,682	0 0
Ashton, Frost & Co.	Willans	3,804	0 0
Mather & Platt	Belliss	3,833	0 0
Siemens Bros. & Co.	Willans	3,895	0 0

SECTION C.—SWITCHBOARDS.

Evered & Co.	£458	0 0	John Fowler & Co. £639 0 0
Williamson & Joseph	514	0 0	P. C. Middleton 674 3 0
Hodgson Wright*	538	0 0	Clayton & Co. 678 5 0
Lea & Warren	542	0 0	Crompton & Co. 696 0 0
Brook, Hurst & Co.	561	0 0	Vaughan 707 0 0
General Electric Co.	575	0 0	Mechan & Son 840 0 0
Andrews	575	0 0	Siemens Bros. 940 0 0
Veritys	620	0 0	

SECTION D.—MAINS.

Western Electric Co.*	£8,301	19 5	Siemens Bros. £10,918 4 11½
St. Helens Cable Co.	9,379	5 8	Oliver 11,311 15 0
Dennis	9,507	2 2	Henley 11,442 0 2
Callender Cable Co.	9,951	18 0	British Insulated Co. 11,564 0 0
Andrews	10,844	19 11	

SECTION F.—ACCUMULATORS.

Hart Accumulator Co.*	£966	0 0	E. P. Storage Company £1,859 0 0
Marquand	1,156	0 0	Chloride Storage Co. 1,402 0 0
Tudor Accumulator	1,265	0 0	D. P. Battery Company 1,446 0 0

SECTION G.—CRANES.

Chatteris Engine Co.*	£148	10 0	James Gerrick £158 0 0
Garrick & Ritchie	149	0 0	James Spencer 160 0 0
Mather & Platt	155	0 0	

*Accepted subject to the consent of the Local Government Board to the loan.

Edinburgh.—The Electric Lighting Committee of the Town Council last week agreed to recommend acceptance of an estimate, amounting to nearly £1,700, for an extension of the switchboard at M'Donald Road station.

Glasgow.—The Electricity Committee of the Corporation last week recommended for acceptance the tender of Messrs. Mechan and Sons for switchboards at Port Dundas electricity station, at £1,122, and the tenders of the International Electric Company and the General Electric Company for the supply of carbons.

Italy.—The Thomson-Houston Company have secured the contract for the electric plant necessary for the operation of the Milano-Gallarte-Varese railway by electricity for the Rete Mediterranean railway authorities.

London.—The London County Council Asylums Committee have accepted the tender of Mr. T. Scott Anderson, of Sheffield, for the electric light, &c., wiring at the Horton Asylum for the sum of £8,700.

The following tenders were received by the Fire Brigade Committee of the London County Council for the wiring and fittings required at the Fulham fire station:—

Tamplin and Makovski (accepted)	£235 4 6
Barlow Bros. & Co.	243 0 0
Concentric and General Contract Company	243 0 0
F. A. Glover and Co.	260 0 0
F. J. Coleby	274 5 0
G. E. Taylor & Co.	298 0 0

Shoreditch.—The Vestry has accepted the tender of Messrs. Babcock & Wilcox for the supply of four marine type water-tube boilers for £5,600, and economisers for £220 per boiler. The Vestry has also accepted the offer of the Hotchkiss Mechanical Boiler Cleaning Company to provide a set of their apparatus for three months' trial free of cost to the Vestry.

FORTHCOMING EVENT.

Friday, July 27th.—6.30 p.m. Institution of Junior Engineers' visit to the generating station and depôt of the Central London Railway, Shepherd's Bush.

NOTES.

A Municipal Failure.—The town of Austin, Texas, has suffered a severe loss in the failure of the huge dam built to develop the power of the Colorado River for purposes of municipal electric light and traction, and power distribution. This dam cost over £250,000, and has been seven years at work. By its failure the city is deprived of light, of water, of street car service, and almost, says the American *Electrical Review*, of hope. There is, it is also said, little hope of the dam being rebuilt, while the bond-holders' outlook is not cheerful. The sympathy of our contemporary is accorded to the people of Austin, who are at the same time pilloried as a spectacle of deep interest and great importance that is urgently commended to the studious attention of every advocate of municipal ownership of any sort. We are not strong advocates of municipal enterprise being carried to extremes, but this does not appear to be an occasion for girding at municipal enterprise. True, the loss is great, and affects a whole town severely, but the loss to the whole community is no greater than if the dam had been the property of a company. We have no particulars of this great dam. We cannot find any in the *Transactions of the American Society of Civil Engineers*. We cannot say if its design was one approved by engineers of experience, or if as with so much of American work, sparsity of population and of rateable value has caused the expense to be unduly curtailed so as to leave too small a factor of safety. Clearly, however, the dam was insufficient for its duty, or it would not have failed. The lesson taught is rather not to construct dams unless they can be well built, —unless there are funds to do this and put all doubts to one side as to their future stability.

Acetylene Gas Headlights for American Locomotives.—Three or four engines were equipped with acetylene headlights on the Chicago Great Western last summer. The trials, however, were not considered a success, and the apparatus has been rejected. The principal cause of failure seems to have been the exhaustion of one carbide compartment before another could be put into operation. Another serious objection recorded by the general shop foreman of the line was that the water in the generator would tend to freeze during the winter. It would appear that both these objections might with care in design be overcome; one would certainly think that it ought not to be difficult to find a place for the generator on a locomotive where water would not freeze. As regards cost, acetylene might be a little more expensive than oil, but the advantages in point of higher candle-power were such that Mr. J. M. Robb was of opinion that it would be to the company's interest to use it if the practical objections he had found to its use could be remedied.

Gutta-Percha.—We understand that there has been a very extensive rise, both in price and amount purchased, of gutta-percha lately.

Personal.—On the occasion of the departure of Mr. W. J. Leeming from the Blackburn Corporation electricity works, for the purpose of taking up his new position of assistant engineer to the electricity department of Buxton, he was made the recipient of a travelling bag, combined silver sovereign case and matchbox, meerschaum pipe, &c., presented by the staff and workmen of the electricity department. Mr. Giles, the chief engineer, who made the presentation, said that he hoped Mr. Leeming would be as successful in his new position as he had been in the past, and that he had the esteem of the staff and workmen he was leaving behind him. Mr. Leeming expressed his sincere thanks for the presents and for the kindness he had met with from all whilst employed at these works.

It is announced by the Eastern Telegraph Company, Limited, and the Eastern Extension, Australasia, and China Telegraph Company, Limited, that the Most Hon. the Marquis of Tweeddale, K.T., has resigned his position as chairman, and that the boards of directors of these companies have elected as his successor Sir John Wolfe Barry, K.C.B. The Marquis of Tweeddale retains his seat as a director on both boards.

We understand that Lord Kelvin is to be the Master of the Clothworkers' Company for the coming year.

Mr. Frank Proctor, who has been engaged for over seven years on electric lighting work in the Post Office factory at Mount Pleasant, has resigned his post in order to take charge of the electrical plant at Earl's Court Exhibition.

Boiler Inspection.—The Select Committee of the House of Commons appointed to inquire into the advisability of legislation to ensure the systematic and regular inspection of boilers, with the object of diminishing the risk to life and property arising from boiler explosions, concluded their labours on Friday last. In their report, according to the *Times*, the committee state that the evidence given before them goes to show that explosions occur in boilers from mistakes or incapacity on the part of the attendant, undue pressure, loss of water, and other causes, and that inspection, however rigid, could not prevent such explosions. At the same time, being satisfied that explosions occur more frequently in uninspected boilers than in those which are inspected by a competent person, they express the view that inspection by a competent person would tend to diminish the risk of explosion. The appointment of inspectors under the Board of Trade is not recommended, inasmuch as the committee hold that the responsibility of selecting a competent person should fall upon the owner or user of a boiler, that the owner should not have the opportunity of sheltering himself behind the inspection of the Board of Trade, and that the inelastic lines upon which Board of Trade inspectors would work would hamper the development of boiler improvement. In regard to the suggestion that the Court set up under the Boiler Explosions Acts, 1882—90, should be empowered to inflict heavy penalties upon owners, users, and inspectors in the event of default, the committee agree that such an extension of the Court's powers would tend to increased boiler inspection; but they think that in such cases an appeal should be allowed, and they find great difficulty in suggesting the Court to which such an appeal should be made.

On the whole, the committee consider that an extension of the Factory Acts, empowering an inspector to call upon the owner or user of a boiler to produce a certificate showing that he has had his boiler inspected by a competent person within a year, and providing that, in cases where the Factory Acts do not apply, this authority should be vested in the police, would make the inspection of boilers practically universal. With regard to hotels, which now come under the category of private houses, the proposal is formulated that the Boiler Explosions Acts, 1882—90, should be so amended as to include hotels and flats. In conclusion, the committee express the opinion that the boiler-making industry has made great strides in recent years; that boilers are, as a whole, better designed, better made, and better managed and understood than they were only a few years ago; that legislation giving any public body whatever control over the inspection of boilers would be a grave mistake; and that certification or registration, unless accompanied by State control, would not be of any practical value.

Herts County Council and the Power Bills.—Our attention has been drawn to a report drawn up by the Parliamentary Committee of the Herts County Council on the North Metropolitan Electric Power scheme, which for misconception and conservatism would be hard to beat. The following quotations from the report will perhaps prove interesting, if painful, reading :—

> The evidence, so far as it has gone, shows conclusively that for many years to come it is *practically commercially impossible* for the company to supply any part of Hertfordshire, perhaps with the exception of Hertford and places south thereof, in the Lea Valley. The supply of electricity in bulk is *quite in an experimental stage*, and it is thought very much against the interests of Hertfordshire that *powers which are practically impossible of being exercised*, if granted, should be given to the company.
>
> If the company be constituted it will probably proceed to constitute other companies within the proposed area of supply for the purpose of utilising electricity. By these means the Hertfordshire County Council *will be compelled for its own protection* in many cases *to become joint promoters of electrical tramway lines which are not wanted, and for the existence of which no justification can be offered.* Failing the County Council becoming such partner with the offshoot undertakings above described, they *will be continually opposing Bills* in Parliament, applications to the Board of Trade, and the Light Railway Commissioners for Orders affecting Hertfordshire roads and other interests.
>
> The committee believe that it is against the best interests of the county to allow three parts of its area to be occupied as proposed by the Bill, for *it is obvious* that if Hertfordshire affords a valuable field for the supply of electricity for mechanical purposes, there will be no lack of substantial companies seeking to supply it with electricity, upon *very much better terms* than will be saddled upon the county if the Bill should be passed into law.

The italics are ours. One cannot help wondering how any responsible engineer could be found to prepare a practically commercially impossible scheme and obtain powers which can never be exercised. What a pitiful spectacle is that of a County Council, obviously in an experimental stage, which is compelled by the march of Progress to defend itself against that monster by promoting unjustifiable and unnecessary tramway lines! Niagara is a myth; Rheinfelden and Schaffhausen are legendary; and County Councils are in their infancy.

Brockie-Pell Arc Lamp Company v. Johnson and Phillips.—This case came before Mr. Justice Kekewich in the Chancery Division yesterday on a motion to commit the defendants for the alleged breach of part of an order made by his Lordship on April 22nd, 1899, by selling certain lamps known by the name of Victoria lamps. The action in which the order in question was made was an action for infringement of certain patents. The order restrained the defendants during the continuance of the plaintiffs' letters patent from manufacturing, selling, or exposing for sale Victoria lamps, and declared that the defendants were not in any other manner to infringe the said letters patent. But the order was not to apply to any Victoria lamps manufactured or sold by the defendants which bore the serial numbers mentioned in the order. The order then went on to state that all further proceedings be stayed except for carrying the order into effect. It was argued by Mr. Warrington, Q.C., on behalf of the plaintiffs, and evidence was tendered to prove the contention, that certain lamps sold by the defendants were practically Victoria lamps. Mr. Fletcher Moulton, Q.C., used all his forensic art to show that there was no identity between them, and called Mr. Johnson, Mr. Esson, and Prof. Silvanus Thompson in support of his arguments. But his Lordship was of opinion that the plaintiff had proved his case; he had no doubt that the defendants had been attempting to evade the order of the Court if possible, and had not succeeded, and there would be an order for committal, and defendants must pay the costs. Mr. Moulton asked for a stay of the order pending an appeal. His Lordship said the order must be drawn up, but a stay would be granted if an immediate application were made to the Court of Appeal. Mr. Moulton said he would apply at once.

Explosion.—A boiler explosion occurred on the premises of the Crystal Palace District Electric Supply Company on Wednesday afternoon, wrecking two large buildings, killing two workmen and injuring three others, besides setting fire to the adjoining premises.

Metropolitan Railway.—In the report of the directors of this company, issued this week, mention is made of the experimental electrical installation at Earl's Court, and it is stated that in view of the importance to the Metropolitan and District Railway Companies of adopting electricity as a motive power, a committee consisting of three members from each of the boards of the companies has been appointed to consider the question of applying electric traction to the working of the inner circle, and it has been agreed between the companies to invite eminent electrical traction firms to submit plans and specifications, with detailed estimates and tenders, for the necessary installation.

Central London Railway.—This railway will be opened for public traffic on Monday, the 30th inst. Trains will begin running from Shepherd's Bush at 5.15 a.m., and from the Bank at 5.20 a.m., stopping at all stations except Bond Street, the opening of which is temporarily deferred. The fares from 5.15 a.m. to 7.30 a.m. will be 2d. return any distance, and from 7.30 a.m. to 12 p.m., 2d. single any distance. For the convenience of the public, books of 24 single-journey tickets will be sold at all stations.

The Electrical Standardising, Testing and Training Institution.—As a result of the recent scholarship examinations, the following awards have been made by the Board of Control of the above Institution :—

To Mr. F. E. Berry, Wellingborough School, Maxwell Scholarship, value 50 guineas, tenable for two years.

To Mr. A. W. Scrooby, of Dunhoved College, a prize value 20 guineas.

The German Electro-Chemical Society.—The seventh annual general meeting of the Deutsche Electro-Chemischen Gesellschaft is to be held in Zurich on August 5th, 6th, and 7th. A number of papers will be read, and visits are to be paid to the works of the Oerlikon Company and to the Polytechnikum.

Appointment Vacant.—A mains superintendent is wanted at the Halifax electricity works.

NEW COMPANIES REGISTERED.

The Northwood Electric Light and Power Company, Limited.—This company was incorporated on June 23rd. The capital of the company is £15,000, divided into shares of £1 each, for enabling the company to carry on at Northwood, Ruislip, and Eastcoate, in the County of Middlesex, and any other places in England, the business of an electric light and power company in all its branches, and the business of supplying electricity for all purposes for which it can be used, and further, to carry on at Northwood an electric or steam and general laundry. The first subscribers are Jno. S. Hignett, Claremont, Northwood, merchant; Acton T. Bucknall, Billiter Street, E.C., solicitor; Arthur W. Crossley, The Elms, Northwood, doctor of science; Chas. Ed. Masterman, Green End, Northwood, civil engineer; C. Hamilton Wickes, Beauleigh, Northwood, merchant; J. W. Tilley, St. Helena, Northwood, merchant; Richd. Crossley, The Elms, Northwood, gentleman. The articles of association have just been issued.

Electromotion Corporation, Limited (66,684).—This company was registered on July 19th, with a capital of £50,000 in £1 shares, to carry on the business of an electric light company and of electricians, mechanical engineers, suppliers of electricity for all purposes, makers of electrical and other lamps, motors and machinery, &c., and to acquire a concession for the supply of electric light and power to the town of Nova Friburgo, Rio de Janeiro, Brazil. The first subscribers are :—A. M. M. De M. Lara, 56, Rue Bassano, Paris, proprietaire, 100 shares; F. V. De Cholet, 111, Rue de L'Université, Paris, 100 shares; C. C. Longridge, Swan House, Copthall Avenue, E.C., consulting engineer, 100 shares; A. W. R. de Forst, 5, Lansdowne Place, W.C., engineer, 100 shares; A. J. Wallach, 3, Temple Gardens, E.C., barrister, 100 shares; A. Gates, 4, Bickenhall Mansions, W., merchant, 100 shares; and L. Kehr, Kaiserlunten, Germany, banker, 100 shares. The number of directors is not to be less than three nor more than seven. The subscribers are to appoint the first; qualification, £100; remuneration as fixed by the company.

SUPPLY STATION ACCOUNTS.

Nottingham Corporation Electricity Accounts.

The accounts of the Nottingham Corporation electricity supply undertaking continue to show most of the satisfactory features we alluded to when summarising the 1897 and 1898 figures The capital expenditure is still very moderate for an output of nearly a million and a half units and nearly 1,600 kw. maximum demand. The increase in capital expenditure is proceeding less rapidly than in the years 1897-98, while the units sold and load are rising even more rapidly, indicating that use is being made to the fullest extent of the considerable extensions carried out to the end of 1898. As we forecasted, the increase in price of coal and general rise in labour charges have inevitably prevented the former rate of progress being maintained, and some of the financial figures show that the burden on the undertaking is increasing, but the excellent management has enabled the increased charges to be easily met, and Mr. Talbot again has to be congratulated upon his works.

General Statement.

	1898.	1899.	Increase.
Total capital expenditure ...	£127,393	**£166,098**	£38,705
Number of units sold	894,674	**1,491,184**	596,510
Maximum demand in kw. ...	1,099	**1,578**	479
Gross revenue	£12,919	**£18,413**	£5,494
Gross profit	£7,774	**£9,673**	£1,899
Average price per unit sold ...	3·34d.	**2·87d.**	– ·47d.

That the increase in output is nearly all due to private supply is shown by the figures of the last five years, given below. It is rather to be regretted that the successful results attained have not induced the Corporation to further extend the public lighting :—

Year.	Units generated.	Maximum load, kw.	Private supply.	Public lighting.	Number of public arc lamps.
1895	183,694	255	160,090	11,564 units.	8
1896	316,638	400	285,622	11,563	8
1897	511,935	737	468,728	11,653	9
1898	951,319	1,099	875,743	18,931	15
1899	1,603,579	1,578	1,470,280	20,904	15

In 1897 the average price received for energy was 5·36d.; it is now well under 3d. The reduction of nearly ½d. has, of course, affected the net profit, for, as will be seen, the costs remain practically at the old figure for 1898. It is probable that this low price would not have been possible had a flat rate been charged instead of the maximum demand principle.

Revenue Statement.

	1898. Gross.	1898. Per unit.	1899. Gross.	1899. Per unit.	Increase.
Sale of energy	£12,429	3·34d.	**£17,833**	2·87d.	– ·47d.
Meter rents, &c.	303	·08d.	**383**	·06d.	– ·02d.
Sale of old material, &c. ..	...	...	**31**	·00d.	·00d.
Connecting consumers and attending public lamps	187	·05d.	**166**	·03d.	– ·02d.
Gross revenue ...	£12,919	3·47d.	**£18,413**	2·96d.	– ·51d.

The "costs" show the effect of the coal famine and consequent increased value in most manufactured articles. "Coal" is higher even than in 1897, while "oil, waste," is also above the per unit figure for 1898. The rises in these two items are practically, although not quite, counteracted by reductions in all the others, but even a captious critic could hardly complain of "works cost" of 1·06d., and "total costs" of only 1·41d.

Cost of Production.

	1898. Gross.	1898. Per unit.	1899. Gross.	1899. Per unit.	Increase.
Coal	£1,610	·43d.	£3,643	**·59d.**	+ ·16d.
Oil, waste, water and engine room stores	376	·10d.	748	**·12d.**	+ ·02d.
Salaries and wages incurred in generation and distribution and attending public lamps.	1,002	·27d.	1,481	**·24d.**	– ·03d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c., and street lamps.	536	·15d.	684	**·11d.**	– ·04d.
Works costs ...	£3,524	·95d.	£6,556	**1·06d.**	+ ·11d.
Rent, rates and taxes ..	277	·07d.	277	**·04d.**	– ·03d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	970	·26d.	1,411	**·23d.**	– ·03d.
General establishment charges, stationery and printing, law charges and insurance.	374	·10d.	496	**·08d.**	– ·02d.
Other expenses	...	...	...	...	...
Total costs ...	£5,145	1·38d.	£8,740	**1·41d.**	+ ·03d.

Having carried a substantial sum to the reserve fund in 1898, a portion of the net profits are now transferred to the credit of the general rate. Owing to the decrease in price received per unit sold

and the augmented interest and sinking fund charges, the net profit is less than in 1898, but is still a substantial amount.

PROFIT STATEMENT.

	1898.	1899.
Interest on loans	£2,579	£4,347
Sinking fund for repayments	1,621	3,175
Net profit carried to reserve fund	3,574	...
" " credit of general rate..	...	2,000
" " forward	...	151
Gross profit	£7,774	£9,673

Stafford Corporation Electricity Accounts.

THE electricity supply undertaking at Stafford is, we believe, run as a sort of annex of the gas works. The Corporation possess an excellent engineer in Mr. J. F. Bell, but it is questionable if the progress of electric lighting would not have been more rapid and pronounced had the works been entirely distinct from the gas department and management. Considering how little onward movement some of the figures, such as capital and load show, the improvement in the financial standing is welcome.

GENERAL STATEMENT.

	1898.	1899.	Increase.
Total capital expenditure ...	£19,620	**£19,950**	£330
Number of units sold	67,988	**86,780**	18,792
Number of lamps connected ...	7,346	**8,558**	1,212
Maximum load in KW.	106	**116**	10
Gross revenue	£1,436	**£1,773**	£337
Gross profit	£653	**£790**	£137
Average price per unit sold ...	4·77d.	**4·60d.**	−·17d.

The revenue of £1,773 is small for a town like Stafford with four complete years of electricity supply. At less than 5d. per unit for all charges the supply ought to be found economical enough to stimulate the demand; and, the rates being 7d. per unit for one hour's maximum demand and 3d. per unit after, or as an alternative 5d. per unit on a uniform price, probably explain the increase in units of nearly 19,000 with but slight alteration in load.

REVENUE STATEMENT.

	1898. Gross.	1898. Per unit.	1899. Gross.	1899. Per unit.	Increase.
Sale of energy	£1,344	4·77d.	**£1,664**	4·60d.	−·17d.
Meter rents, &c.	76	·27d.	**86**	·24d	−·03d.
Supply of lamps, &c.	...	...	...	...	...
Sundry fees, rents received, &c.	16	·05d.	**23**	·06d.	+·01d.
Gross revenue ...	£1,436	5·09d.	**£1,773**	4·90d.	−·19d.

It would not require any very extraordinary expenditure to affect the "costs." When one is dealing with £2 per week for fuel and £1 per day for wages, things are cut fine, and the increases in the items might be expected. As wages have been kept almost constant, the decreased value per unit under this head wipes out the rises in the others included in works cost. The sum of £34 in 1898 was spent in "electric fittings."

COST OF PRODUCTION.

	1898. Gross.	1898. Per unit.	1899. Gross.	1899. Per unit	Increase.
Coal	£70	·25d.	£116	**·32d.**	+·07d.
Oil, waste, water and engine room stores.	14	·05d.	30	**·08d.**	+·03d.
Salaries and wages incurred in generation and distribution	354	1·26d	390	**1·08d.**	−·18d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	145	·51d.	214	**·59d.**	+·08d.
Works costs	£583	2·07d.	£750	**2·07d.**	...
Rent, rates and taxes ..	133	·47d.	178	**·49d.**	+·02d.
Management expenses, salaries of managing engineer, secretary, clerks, &c,	8	·03d.	8	**·03d.**	·00d.
General establishment charges, stationery and printing, law charges and insurance	25	·09d.	47	**·13d.**	+·04d.
Sundry lamps and fittings ..	34	·12d.	...	...	−·12d.
Total costs ...	£783	2·78d.	£983	**2·72d.**	−·06d.

Works costs of 2·07d. and "total" of 2·72d. may be regarded as very good indeed for a most moderate output. The salaries are certainly minute, the £8 being the auditor's fee; apparently the electrical superintendent is included in the "salaries and wages" item.

The financial result shows a diminished loss, the deficit of £513 in 1898 being now reduced to £374. The improvement amounting to £139 is due to the improved load factor; the costs having remained practically the same, and no appreciable addition being made to interest and sinking fund charges, the extra output and consequent revenue has helped the result very greatly. At the present rate another year or two ought to see the business turning the corner.

PROFIT STATEMENT.

	1898.	1899.
Interest on loans	£579	£560
Sinking fund for repayments	587	604
Net profit, being deficiency carried forward	−513	−374
Gross profit	£653	£790

CITY NOTES.

British Thomson-Houston Company, Limited.

THE fifth ordinary general meeting of the shareholders of the above company was held on Monday at the offices, 83, Cannon Street, under the chairmanship of Mr. E. A. Lazarus.

In moving the adoption of the report, the CHAIRMAN said there was little to say, as the report was as full as they could make it. They would be pleased to hear that their books were pretty full with orders, and they were rather pleased with the basis of the thing. Formerly they found they had six or seven or eight or ten big orders, but now they found they had broadened out a good deal, and while they still had big orders, they had a good many others which were not so large as the Central London Railway or things like that. The principal orders they now had were at Birkenhead, Blackburn, Bristol City trams, Croydon, Dublin City trams, Glasgow, Huddersfield, Hull, Isle of Thanet, Queenstown, Leeds, London United, Newcastle, Sheffield, Tynemouth, and some others. Their works at Rugby were getting on very nicely, and he hoped by the time he next met them they would have commenced to work. They had begun paying for part of the work, and had decided to make a call of £2 10s. from September 1st, which would make £6 paid, and then probably they would go on calling up the other £4, £2 in each two months, according to the legal delay, but that would depend upon whether they actually wanted the money or not. General Griffin, who was on the board on behalf of the General Electric Company, had written that he could not come across so often, and the General Electric Company had been good enough to propose Mr. W. J. Clark to replace him. He was one of the officials of the General Electric Company, and they would derive a good deal of benefit from his close connection with them. He would like on general matters to seize that opportunity of calling attention to two points. First, was the desirability of consulting engineers advising their clients to have standard plant as far as possible. They knew that there were special cases where special plant must be used, but they thought that it would be very much to everybody's advantage if standard plant was ordered. He did not mean specially their plant, but that buyers in choosing their new plant should adhere as much as possible to the standard practice of either of the large manufacturers. They would, by so doing, get better and cheaper plant. Then the other matter he would refer to was the growing ideas of municipalities in respect to electrical matters; they had noticed, so far as they were concerned, that one of the results of that was that tenders, as a rule, went to the lowest tenderer. They could quite understand how that happened, because it was a very difficult matter for a mixed body of people to decide what to do when they were voting money for a highly technical matter like the buying of electric plant. But they did feel that that habit of simply taking the lowest tender was apt to reduce the value of the whole of the plant, because that forced firms of a lesser standing perhaps than the few at the top of the tree to tender and take risks which it was neither to their advantage nor to the buyer's advantage should be taken. They could understand that in that class of trade very often a small initial expenditure meant a very much larger one later on, firstly, because the efficiency of the plant delivered might not be as high as it might be, and, secondly, because the cost of maintenance and repairs rises in proportion, as the plant itself is not quite tip-top. When a municipality embarked on an undertaking which it was going to stick to for 30 or 40 or 100 years, it certainly was not to its advantage to buy cheap stuff. He did not say that because they did not cheapen their stuff. Their feeling was that the best and the safest thing they could do in the long run was to adhere to their principle of selling the best plant and asking a proper and reasonable price for it, and if they did not get that they did not regret seeing the order go elsewhere.

Sir T. THOMPSON seconded the motion, which was carried.

The CHAIRMAN then moved—"That the following dividends be now declared out of the net profits of the undertaking for the 12 months ending March 31st, 1900, upon the capital issued on that date, viz.:—On the £240,000 ordinary shares fully paid a dividend of 10 per cent. for the year. On the £160,000 ordinary shares of which £16,000 were paid up from August 15th, 1899, a dividend at the rate of 10 per cent. for the year, and that these dividends be paid on July 24th, 1900."

Mr. MCARTHUR, M.P., seconded the motion, and it was agreed to.

The retiring directors and auditors having been re-elected, Dr. MERZ moved a vote of thanks to the chairman.

Col. MARTINDALE, in seconding the motion, congratulated the board on the admirable result of the past year's working, and asked to include the board in the vote of thanks.

The CHAIRMAN, in replying, said he would like not only the board but the staff to be included in the vote, for they well deserved it.

Direct United States Cable Company, Limited.

The ordinary general meeting of the shareholders of this company was held on Tuesday last at Winchester House, Old Broad Street, E.C., Mr. Emanuel M. Underdown presiding.

In moving the adoption of the report, the Chairman said they had been fortunate in the half year under review in that they had not had to do any repairs to their cables. The revenue for the half year after deducting out-payments amounted to £52,204. The working and other expenses, including income-tax, amounted to £20,506, leaving a balance of £31,698 as net profit, making with the £6,347 brought forward from the previous half-year a total of £38,045. The interim dividend of 3s. per share paid on March 31st, amounted to £9,106, and the proposed final dividend of 3s. per share, together with a bonus of 2s. per share, amounted to the sum of £15,777; transfer to the reserve fund £10,000, leaving a balance to be carried forward of £3,761, making altogether the figure £38,045. The revenue showed a small improvement of £253, as compared with that of the corresponding half-year. The working expenses in London showed a saving of £217. The item of income-tax on all their profits and outstanding statements showed an increase of £95. Practically they would find the results were the same as last year. As he had mentioned there had been no interruption with the cables, and consequently they did not have to draw anything from the reserve fund, which had been increased by £10,000 transferred to it from revenue; by £6,782 interest on the investments, which together with £379 derived from other items brought the fund up to a total of £418,875. The investments had been increased by £21,206, and they now amounted to £401,807 at cost price, but their present market value was £25,000 higher than that figure. The investments had been chosen with the greatest care, and on the whole they had turned out well, yet the profits arising therefrom were not so large by a considerable amount as they were a few years ago. A substantial profit, however, was still shown, and when the present financial depression had passed away, he hoped their investments would exhibit a more satisfactory increase on their cost price than they did at present. The total revenue for the whole financial year had amounted to £109,004, and after deducting expenses, there was a balance of £68,081, of which £42,497 had been disbursed in dividends, £25,000 had been added to the reserve fund, and there was an increased balance in hand of £584. As far as their service was concerned, it had been conducted with great success and regularity. Their relations with the allied companies had, as usual, been exceedingly good. They were endeavouring to hold their own, but the increase of cables across the Atlantic was a matter of very considerable importance. As soon as the German cable was opened there would be 13 cables across the Atlantic, and if a shorter section from Nova Scotia to the Azores were spanned, there would be practically 14 cables. All that the company could do in connection with their allies was to conduct their cables as best they could, and endeavour to keep their position as sure as possible. With regard to their relations with the German messages, they had not yet been altered, because although the contract was, so to speak, at an end, yet messages were still being transmitted over the cable connected with the Anglo-American Company from Valencia to Germany over the German cable, but, of course, they could not expect that arrangement would continue indefinitely. The attention of the board had been very closely directed to the matter, and they had had many interviews in influential quarters, and trusted that as far as possible the interests of the pooling companies would be well looked after.

Sir James Pender, M.P., seconded the motion, and the report was adopted.

Crompton & Co., Limited.

The twelfth annual report of the directors, to be presented at the annual general meeting of the shareholders at the City Terminus Hotel, Cannon Street, E.C., on 30th inst., is as follows:—

"The annual statement of accounts made up to March 31st last shows a satisfactory profit for the year of £31,326 19s. 6d. After providing for debenture interest, payment of interim dividend, and other items set out in the revenue account, there remains, with the sum brought forward from last year, a balance of £24,636 14s. 10d. The directors propose to set aside the sum of £2,500 as a provision for doubtful debts, to place £12,000 to the reserve fund, to pay a dividend at the rate of 9 per cent. per annum for the half-year, free of income-tax, making, with the interim dividend paid in January last, 7½ per cent. for the year, and to carry the balance, £3,729 18s. 11d., forward. With the above addition of £12,000 the reserve fund will now stand at £25,046 9s. 9d. The directors propose to set aside from this account a sum of £5,000 as a special contingency fund, to provide for any possible shrinkage in the value of investments, to write off £5,000 from the goodwill account, £5,000 from the patents account, and £3,000, balance of the cost of establishing the electric cooking department, carrying the balance, £7,046 9s. 9d., forward. The whole of the 21,902 shares, offered for subscription in July last year, were taken up, and the premiums have been carried to the reserve fund. The board have purchased an additional 10½ acres of freehold land adjoining the site of the new works. They have considerably extended the main shop at these works, which is now being equipped with the necessary machinery, and have also erected a detached pattern store. The business of the company continues to progress in a most satisfactory manner, and the order book is very full. The Chelmsford Electric Lighting Company have hitherto been occupying a portion of the old works at Chelmsford for a generating station; a formal conveyance of the freehold, together with the plant and machinery therein, has now been made to the company, thereby nominally increasing the investment in that undertaking, the full amount of which is set out in the accounts. The administration of that company has been thoroughly re-organised during the past year, and it is believed that the results for the current year will show very considerable improvements. This undertaking, which is owned by Crompton & Co., Limited, is earning a moderate but steadily increasing revenue, and the directors are of opinion that this improvement will continue. In accordance with the articles of association Mr. John Trotter retires from the board of directors by rotation, but offers himself for re-election. The auditors, Messrs. J. H. Duncan & Co., also offer themselves for re-election."

City and South London Railway Company.

The directors' report for the half-year ending June 30th, 1900, to be submitted to the half-yearly meeting of the company, to be held at Winchester House, E.C., on Tuesday, July 31st, at 12 o'clock noon, reads as follows:—

"The receipts from all sources for the past half-year have amounted to £35,144 18s. 2d., and the cost of working has been £20,860 12s. 8d., leaving a profit of £14,284 5s. 6d. Inclusive of the balance brought forward from December 31st last, the net revenue account shows an aggregate total of £18,366 12s. 2d. After making provision for the debenture stock interest, a balance remains available for dividend of £13,215 4s. 7d. Out of this sum your directors recommend that the full dividend of 5 per cent. per annum be paid on the preference stocks, 1891, and four months on those of 1896 (the other two months being charged to capital as authorised), and that a dividend at the rate of 1¼ per cent. per annum be paid upon the consolidated ordinary stock, leaving a balance of £7,8 2s. 11d. to be carried forward to the next account. The following table shows the number of passengers, exclusive of season ticket holders, carried since the opening of the railway in each half-year:—

Half-year.	Number of passengers (exclusive of season ticket holders).	Receipts (including season tickets). £ s. d.
Ended December 31st, 1890 (11 days)	165,000	1,568 3 9
„ June 30th, 1891	2,412,343	19,403 6 9
„ December 31st, 1891	2,749,055	19,798 16 6
„ June 30th, 1892	2,813,163	20,931 4 2
„ December 31st, 1892	3,117,603	22,002 17 5
„ June 30th, 1893	3,146,656	22,458 6 9
„ December 31st, 1893	3,098,351	22,067 14 10
„ June 30th, 1894	3,383,154	23,564 10 6
„ December, 1894	3,275,649	23,540 12 4
„ June 30th, 1895	3,113,199	23,711 5 8
„ December 31st, 1895	3,17?,488	23,7?0 8 7
„ June 30th, 1896	3,19?,673	24,021 13 0
„ December 31st, 1896	3,868,480	25,456 6 9
„ June 30th, 1897	3,437,810	26,403 3 6
„ December 31st, 1897	3,337,861	26,47? 19 10
„ June 30th, 1898	3,478,977	26,356 16 4
„ December 31st, 1898	3,462,814	26,519 14 10
„ June 30th, 1899	3,540,098	26 749 3 0
„ December 31st, 1899	3,442,942	26,197 14 10
„ June 30th, 1900	4,169,717	31,608 2 3
Total since the opening of the line ..	61,872,980	£463,412 9 7

Your directors regret the diminution in the dividend, which is largely attributable to the increase in the debenture and preference charges before the recently opened extensions have had time to develop their traffic. There has also been a considerable increase in the cost of coal, wages and materials. Your directors have the pleasure to report that the extensions to Moorgate Street and Clapham Common were opened for traffic on February 26th and June 4th respectively. The receipts have already been considerably augmented, and are steadily improving. The extension to Islington is being rapidly proceeded with, and it is hoped will be ready for opening about March next. Both tunnels are nearly completed, and the stations are progressing. The Central London Railway not having yet been opened for public traffic, the joint subway constructed for the exchange of traffic between the two companies at the Bank station has not been brought into use. The joint subway with the Brighton Company at London Bridge is in course of construction. The important additions and alterations at the generating depôt, alluded to in previous reports, are practically completed, and the further plant required for the Islington extension is in hand. In preparation for the opening of this portion of the line 10 additional locomotives have been ordered.

"*Parliamentary.*—The Bill promoted by this company in the present session has received the Royal assent. The consent of the proprietors was obtained to an arrangement between this company and the Baker Street and Waterloo Railway Company, who are obtaining powers to extend their line to the Elephant and Castle Station, where it is proposed to have a subway communication between the two systems, which will, it is hoped, result in a large exchange of traffic. The interests of your company are fully protected.

"*City and Brixton Railway.*—At the extraordinary meeting resolutions will be submitted varying the present agreement with the City and Brixton Company, with the view of facilitating the raising of the capital of that company.

"*New Offices.*—The station buildings at Moorgate Street being nearly completed, the offices of the company will be removed there immediately. The upper floors of the building have been let at remunerative rentals. It is proposed to redecorate and otherwise

improve the present offices at 46, King William Street, with a view to letting them until they are taken over by the City and Brixton Company.

"It is with much regret that your directors have to report the death of their colleague, Mr. Sampson Hanbury. He had been a director of the company from its formation, and took a very earnest and active interest in its affairs. The dividend warrants will be posted on the 8th prox."

The Edison & Swan United Electric Light Company, Limited.

The seventeenth annual report of the directors, for the year ending June 30th, 1900, to be presented at the annual general meeting at Cannon Street Hotel, on the 31st inst., states that the profit and loss account shows a credit balance of £43,388 1s. 5d. Providing for the interest upon the debenture stock, there remains a balance of £29,208 11s. 11d., available for distribution. An interim dividend at the rate of 6 per cent. per annum having already been paid in respect of the half-year ending December, 1899, a further payment, at the rate of 6 per cent. per annum, for the second half is recommended, making the dividend for the book year 6 per cent. per annum, the balance of £6,199 18s. 5d. being carried forward. The issue of the £100,000 5 per cent. second debenture stock was duly made and fully subscribed. A quotation has been granted by the Stock Exchange. James Staats Forbes, Esq., and the Right Hon. the Earl of Lichfield, retire by rotation from the board, and offer themselves for re-election. Messrs. Welton, Jones and Co., the auditors, offer themselves for re-election.

British Electric Transformer Manufacturing Company, Limited.

The report of the directors for the year ending June 30th, 1900, to be presented at the general meeting at Faraday House, August 3rd, states that after paying all manufacturing costs and expenses of administration, and providing for repairs and depreciation, there remains a net profit of £6,184 8s. 9d., which, with the amount brought forward from last year, makes a present total available balance of £6,421 17s. 10d. The board propose to deal with this as follows:—By payment of a dividend, at the rate of 10 per cent. per annum, on the subscribed capital (one-half of which was paid as an interim dividend on February 9th, 1900), and a bonus of 2½ per cent. for the half-year ending June 30th; by carrying £2,500 to reserve fund; and carry forward £1,802 5s. 5d. As the lease of the present works expires next year, the board are negotiating for the purchase of land for the erection of new works near to London, which they expect to be able to erect and equip without increasing the present capital. The business continues to show a steady rate of progress. The retiring director is Mr. R. Stewart Bain, who is eligible for re-election. The auditors, Messrs. Monkhouse, Stoneham and Co., also retire, but offer themselves for re-election.

Rand Central Electric Works.

The report of the directors of the Rand Central Electric Works, Limited, for 1899, to be presented at the ordinary meeting to be held in London on 31st inst., states that as a consequence of the war communication with Johannesburg has for some time been exceedingly difficult, and at times altogether impossible. Business and mining work were brought to a standstill early in October of last year, and as the company depends for its revenue upon these sources, it must be considered a favourable feature that it was at least able to pay its expenses during the last quarter of the year under review. The total revenue received amounted to £50,674, as compared with £43,208 in 1898, and the working costs to £49,834, as compared with £48,951 in 1898. The profit thus amounts to £840, of which £84 is carried to reserve, against a loss of £5,742 made in 1898. The receipts for power supplied amount to £49,640, against £42,723 received in 1898. Under normal circumstances, and calculated on the possible output of power contracted for, the receipts might have been £10,000 to £15,000 in excess of the amount now shown, as the installed power rose from 1,845 to 2,219½ H.P. Negotiations for further power contracts were in progress when the war broke out, and after the conclusion of peace they will be taken up again. A further expenditure of £1,375 was made to increase the water supply. Under the equipment contract Messrs. Siemens and Halske guaranteed that the profits of the company should be sufficiently large to provide dividends at 6 per cent., 8 per cent., and 10 per cent. per annum respectively for 1897, 1898, and 1899. The necessary amounts to provide the guaranteed dividends for 1897 and 1898 were duly paid, and the one now under consideration is due; but in regard to the profits for 1899, Messrs. Siemens & Halske claim a partial release on account of the hostilities in South Africa, constituting a case of *force majeure*. After lengthy negotiations with Messrs. Siemens and Halske, the board has arrived at a basis of adjustment in respect of the profits of 1899. The directors propose to relieve the contractors of the necessity for paying £7,371. Under this arrangement there will be £22,628 available for distribution. The directors propose a dividend of 7½ per cent. for 1899, payable when and so soon as the necessary payment by Messrs. Siemens & Halske is made. Mr. R. Charubin has resigned his seat on the board in consequence of his removal to the Continent, and a further vacancy has occurred through the death of Mr. A. Barsdorf. Mr. G. von Chauvin has been elected to fill one of the vacancies.

British Columbia Electric Railway Company, Limited.

Mr. R. M. Horne Payne (chairman) presided on Wednesday over the fourth ordinary general meeting of the above company, held at the Cannon Street Hotel, and said that as he had recently addressed them at considerable length on the business of the company, and as the heat was so oppressive, he would formally move the adoption of the report (which appeared in the Electrical Review of last week).

Mr. A. C. Mitchell seconded the motion, and it was carried without discussion.

An extraordinary meeting followed, at which the following resolution was carried:—"That the articles of association be altered by the substitution of the following article for Article 89: The directors shall be paid out of the funds of the company by way of remuneration for their services in each year the following sums, namely:—The director who shall for the time being act as permanent chairman of the board shall be paid the sum of £200 per annum, and each of the other directors shall be paid the sum of £133 per annum, and in addition to such annual sums the directors shall be entitled to a sum equal to £10 per cent. of the profits of each year after payment thereout of a dividend of 5 per cent. per annum on the issued capital, such percentage to be divided among them in such proportion and manner as the directors may determine."

The Alderley and Wilmslow Electric Supply, Limited.

The fifth annual general meeting of shareholders was held last Friday.

The Chairman of the board (Mr. F. E. Gripper), in presenting the accounts, explained that the works were opened on October 5th, 1899, at a cost of £16,074. The number of lamps connected at this time was 438 8-c.p., and at the end of December, 1899, these had increased to 1,223; the number of consumers was increasing daily, and it was anticipated that by the end of the present year 3,000 lamps would be connected. The "free" wiring system had been adopted by the company. The prepayment system had also been taken up by the company, and consumers were now enabled to have "penny-in-the-slot" meters supplied to them. The need for the insertion of a coin in the meter for a fresh supply was noted by the dim burning of the lamps, the light not being extinguished as in the case of gas meters. Regarding the negotiations with the Urban District Council of Wilmslow for the supply of light to that district he felt that the terms offered by the company to the Council were most favourable, and he anticipated that an interview would be arranged with the committee to further discuss the matter. The resident engineer reported that Dr. Wilde had been and was conducting a series of experiments with his new search light, which caused a large strain upon the works of the company, but the supply was found equal to cope with it. The light, a very strong one, was seen for many miles around. The retiring director, Mr. F. E. Gripper, was re-elected.

Aluminium Company, Limited.

According to the *Times*, the report of the directors to be submitted to the meeting on the 26th inst., at Cannon Street Hotel, E.C., for nine months ended March 31st shows a profit of £19,684. After deducting debenture interest and other charges, the net profit is £13,508, which, with £5,501 brought forward, makes an available balance of £19,009. The directors recommend a dividend at the rate of 15 per cent. per annum for the nine months, which will absorb £7,312, leaving £11,697 to be carried forward. The alteration in the financial year and date of making up the accounts is in consequence of a working agreement which has been entered into with the Cassel Gold Extracting Company, Limited. The directors have considered proposals made for the amalgamation of this company with the Castner-Kellner Alkali Company, and they have entered into a provisional agreement for the sale to the Castner-Kellner Alkali Company of all the property of this company other than the shares of the Castner-Kellner Company held by this company. The report of the meeting will appear in our next issue.

Eastern Telegraph Company, Limited.

The fifty-sixth half-yearly general meeting of the shareholders of this company was held on Thursday of last week at Winchester House, Old Broad Street, the Marquis of Tweeddale presiding.

The Chairman in proposing the adoption of the report, said that the gross revenue for the half-year amounted to £543,683, being an increase of £50,180. Analysing the receipts they found there had been an increase generally in the traffic, but more especially in that from South Africa. India, however, again showed a decrease as compared with the corresponding period of last year of £3,500. The total ordinary expenditure for the half-year amounted to £128,072, being an increase of £5,511. The expenses attending repairs and renewals to cables amounted to £27,939 as against £34,520 last year, or a decrease of £6,581. That was to a large extent due to the extra credit received on account of the hire of their ships by other companies and Governments. A further reduction from 4s. 9d. to 4s.

per word had been made in the tariff between Europe and the Colonies of South and Western Australia and Tasmania which came into operation last May, and the agreement with the Colonies provided for further reductions under certain conditions to a minimum of 2s. 6d. per word. Substantial reductions in the tariff between the contracting Colonies and South Africa would also come into operation when the new cables between Durban and Perth were completed. Further reductions would also take place in the tariff between Europe and the Cape in accordance with arrangements made between the company, the English Government and the Governments of Cape Colony, Natal, and others interested. Negotiations were also in progress for a reduction in the tariff between Europe and India, and the delay in the arrangements had been caused by the fact that the various administrations interested in the tariff had under the regulations of the International Telegraph Convention to be first consulted. As far as their company was concerned, they had consented to a reduction from 4s. to 2s. 6d., and a further reduction to 2s., under certain conditions. That company, therefore, was in no way responsible for the reductions not yet having been given effect to. The effect of those important reductions would doubtless be to increase the volume of the traffic, but it must be remembered that they could only earn the same amount of revenue in the future as they had done in the past by performing a much greater amount of work. That, in its turn, necessitated a larger staff, and a consequent increase of various expenses incidental thereto. Another and more important factor which those reductions in tariff meant was an additional outlay for new cables. The reduction of rates and increased cable capacity were very closely connected, and considering the enormous outlay involved in laying new cables, reduction in rates must only be done gradually, and with the utmost caution, as a considerable time must necessarily elapse before the traffic developed sufficiently to give a fair return on the additional expenditure. Whatever might have been said to the contrary, the history of the company had proved that wherever the traffic had shown sufficient signs of expansion they had always been ready to meet the need. The company had now reached a position which it might be justly proud of, and he thought it must be admitted by all those who had watched its progress that its present prosperity was the result of careful and judicious management, and it was by that means that that financial position had been arrived at which made it possible for them to undertake the responsibility of expending large sums on new cables. A charge had been made against the company that the stockholders had received excessive dividends, but in his opinion the amount distributed by way of dividend could not fairly be held to be unreasonable considering the peculiar nature of their property. The amount distributed on the capital of that company and the Eastern and South African Company—of which they hold the whole of the share capital—was a little under 5½ per cent.—5·43d. per cent. With regard to the amount of their reserve fund, it was held by those responsible for the management that the business of a submarine telegraph company could only be adequately conducted by sufficient provision being made for depreciation, so that cables could be renewed as they wore out and additional cables could be laid as required without creating heavy additions to the capital account; and it was only by adhering to that policy that further reductions in tariffs could be made. Since the early part of last year their company and the Eastern Extension had incurred liabilities for new cables amounting to over £3,200,000. That was the 28th complete year of the existence of the company, during which time wonderful developments had taken place in submarine telegraphy, and he was proud to be able to say that the company now stood in a better position both financially and from the point of view of efficiency than it ever did. The noble marquess then gave a short history of the company from its commencement in 1872. He said it started with a capital of £3,397,000, which had increased to £7,262,098. In 1872 the gross revenue was £376,922; last year it amounted to £1,018,634. The amount distributed among the ordinary stockholders last year was the same as in 1872. Not very long ago the stockholders were somewhat startled by reports which appeared as to the developments of wireless telegraphy and the probability of its displacing submarine cables. Without discounting the usefulness of wireless telegraphy under certain conditions, he wished to say that he still held the opinion which he expressed some time ago, that instead of becoming a rival to their system, it might possibly form a useful adjunct under certain circumstances. The directors had subscribed to the Transvaal War Fund, the C.I.V. Fund, and the Indian Famine Fund, and since the report was issued they had given an additional £500 to the Indian Famine Fund, feeling sure that in so doing they would be consulting the wishes of the proprietors. In conclusion, the chairman said that that would be the last time he would occupy the chair at the meetings, because advancing years, together with an increase in the business of the company, rendered it desirable, in his opinion, that the chair should be filled by a younger man, and he was glad to say the board had appointed Sir J. Wolfe Barry to succeed him as chairman of the company.

Sir J. Wolfe Barry, in seconding the motion, expressed the satisfaction it gave him in having been unanimously asked by his colleagues on the board to accept the chairmanship, and said he would be pleased to place his services at the disposal of the company, which he considered was doing a work of national importance.

Mr. Newton, in supporting the resolution, referred to the gratitude which the proprietors owed to the Marquis of Tweeddale for his long services to the company, and said he was pleased to think that although the Marquis was giving up the chairmanship, the board would still have the benefit of his advice and assistance.

The report was then adopted, and a vote of thanks passed to the chairman for presiding, concluded the proceedings.

The Globe Telegraph and Trust Company, Limited.

The report of the directors, to be submitted to the twenty-seventh ordinary general meeting at Winchester House, July 27th, 1900, shows that the net revenue of the company for the year ended July 18th, 1900, after deduction of expenses, amounts to £198,420 4s. 1d., and makes, with the balance of £1,091 2s. 9d. brought forward, a total of £199,511 6s. 10d. From this amount there has been distributed the sum of £132,321 10s. 9d. in interim dividends, leaving an available balance of £67,189 16s. 1d. The directors recommend the payment of a final dividend for the year of 3s. per share on the preference shares, and of 4s. 6d. per share on the ordinary shares, making, with previous distributions, a total dividend for the year of 6 per cent., less income-tax, upon the preference, and 5¼ per cent. net (against 5¼ per cent. for the preceding year) upon the ordinary shares, leaving a balance of £982 14s. 11d. to be carried forward to the next account. During the year the Eastern Extension, Australasia, and China Telegraph Company, Limited, and the Commercial Cable Company, have both issued new share capital, which was offered to the shareholders of those companies *pro rata* to their holdings, the former at £13 per share, and the latter at par. The full number of shares thus offered has, in each case, been taken up by this company, the cost being met by the sale of other securities. The name of the Brazilian Submarine Telegraph Company, Limited, has been changed to that of the Western Telegraph Company, Limited. The 4 per cent. debenture stock of the Western and Brazilian Telegraph Company, Limited, held by this company, has been exchanged for 4 per cent. perpetual debenture stock of the Western Telegraph Company, Limited. In conformity with the articles of association, one of the directors, viz., Sir James Pender, Bart., M.P., retires, and being eligible, offers himself for re-election. The auditors, Messrs. Deloitte, Dever, Griffiths & Co., and Mr. John Newton retire, and offer themselves for re-election.

Anglo-American Telegraph Company, Limited.

The directors' report to be submitted to the half-yearly meeting to be held at Winchester House, on Friday, July 27th, at 2 o'clock p.m., reads as follows:—

The total receipts from January 1st to June 30th, 1900, including the balance of £1,255 2s. 11d., brought forward from the last account, amounted to £186,526 8s. 11d. The traffic receipts show an increase of £982 as compared with the half-year ended June 30th, 1899. The total expenses of the half-year, including the repair of cables, &c., as shown by the revenue account, amounted to £60,784 1s. 4d., being a decrease of £243 2s. 11d. as compared with the corresponding period of 1899. The directors, under the powers conferred upon them by the articles of association, have, before declaring the net profits, set apart the sum of £17,000 to the renewal fund, leaving a balance of £113,742 7s. 7d. One quarterly interim dividend of 15s. per cent. on the ordinary stock, and of £1 10s. per cent. on the preferred stock, was paid on May 1st, 1900, absorbing £52,500, and a second quarterly dividend of 15s. per cent. on the ordinary stock, and £1 10s. per cent. on the preferred stock, amounting to £52,500 will be paid on August 1st, 1900. The balance of £8,742 7s. 7d. will be carried forward to the next account. The cables and landlines of the company are in good working order.

Prospectuses.

Full particulars will be found elsewhere in this issue of the issue of 19,370 five per cent. cumulative preference shares of £5 each, at par, in the Dudley, Stourbridge, and District Electric Traction Company, Limited, which is being placed before the public by the Electric and General Investment Company, Limited, on behalf of the guarantors, the British Electric Traction Company, Limited. The share capital authorised is £200,000 in £5 shares, divided into 20,000 ordinary shares, and the same number of preference shares; the whole of the ordinary shares have been issued, and the present issue completes the preference share capital.

A map is published with the prospectus, showing the tramways completed (5½ miles in length) and the light railways which have been authorised (11½ miles in length). The working of the tramways has resulted in a net profit for each of the last five years, the amount last year being £4,309; the present annual profit is sufficient to provide the dividend on the whole of the preference shares, and it is anticipated that before the end of the current year 8½ miles of new line will be working. A large number of contracts and agreements which have been entered into are tabulated in the prospectus.

It will be seen that the undertaking is on sound business lines, and there is every prospect of a prosperous future before the company; the system of tramways completed and constructing connects together a number of industrial townships which had a population of over 130,000 in 1891, and it is just that sort of network that confers such great benefits on the community, and can only be satisfactorily undertaken by a company. We wish it every success.

The Blackheath and Greenwich District Electric Light Company, Limited, offered for subscription this week £100,000 (part of an authorised issue of £120,000), 4½ per cent. first mortgage debenture stock, convertible at par into 7 per cent. cumulative preference shares after June, 1905. The list opened on the 23rd and closed on the 25th inst. The authorised capital of the company is £300,000, divided equally into ordinary shares and 7 per cent. cumulative preference shares of £1 each; the capital issued and fully paid up is £101,200 ordinary shares. The company's area covers about 15 square miles, and the lamps connected number over 10,000; the generating station is capable of supplying 80,000 lamps. The present issue is for the equipment of the area added by a provisional order obtained last year, and for general purposes.

County of London and Brush Provincial Electric Lighting Company, Limited.—The subscription list opened on Tuesday, 24th, and closed on Thursday, 26th inst., for a new issue of £100,000 4½ per cent. debenture stock at the price of £108 per cent., ranking with the £200,000 stock already issued, and redeemable at £115 per cent. in the event of the voluntary liquidation of the company, or on six months' notice after December 31st, 1923. The matter is in the hands of the Electric and General Investment Company, Limited. The total authorised debenture stock is £400,000, of which one fourth remains unissued. The prospectus does not set forth the purpose for which the new capital is required, but it is stated that the total assets are £917,313 16s. 11d., and that the estimated net revenue for the current year from the company's London stations will amount to nearly three times the interest on the whole of the debenture stock. The number of lamps or their equivalent connected or applied for within the county of London amounted on June 30th last to 178,137 8-C.P. lamps. The directors have declared an interim dividend on the preference shares of the company at the rate of 6 per cent. per annum, less income-tax, for the half year ending June 30th, 1900, and an interim dividend on the ordinary shares of the company for the same period at the rate of 4 per cent. per annum, less income-tax, both payable on August 15th.

Notting Hill Electric Lighting Company, Limited.—After conferring with representatives of the founders' and ordinary shareholders, at a meeting on the 17th inst., the directors have decided to increase the capital of the company to £200,000, by the creation of 10,000 new shares of £10 each, ranking as ordinary shares. The present issue is to consist of 2,200 shares, at a premium of £2 per share, 1,100 of which will be offered to the holders of founders' shares, and the remainder to the ordinary preference and the ordinary shareholders. This proportion is to be maintained in future issues. An extraordinary general meeting of the company is to be held at Winchester House on August 1st, to pass resolutions confirming this decision.

Liverpool Overhead Railway Company.—The accounts of this company for the past half-year show an available balance of £14,202, and the directors have resolved to recommend payment of a dividend at the rate of 5 per cent. per annum on the preference shares, and 3 per cent. per annum on the ordinary shares, against 2½ per cent. per annum on the ordinary shares for the corresponding period last year. Balance carried forward £4,452 against £4,320.

The City of London Electric Lighting Company, Limited.—Mr. Joseph Bevan Braithwaite, jun., of 27, Austin Friars, E.C., and Mr. Herbert Samuel Leon, J.P., of Bletchley Park, Bletchley, Bucks, have been elected to seats on the board of this company.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending July 21st, 1900, were £1,491 7s. 3d.; receipts for corresponding period, 1899, £1,971 17s. 11d.; aggregate for half-year to date, £3 241 15s. 9d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending July 20th, 1900, were £3,605 1s. 9d.; corresponding period, 1899, £3,677 0s. 10d.; decrease, £71 19s. 1d.

The City and South London Railway Company.—The receipts for the week ending July 22nd, 1900, £1,411; July 23 d, 1899, £?64; increase, £547. Total receipts for half-year, 1900, to date, £4,294; corresponding period, 1899, £2,762; increase, £1,532. Miles open, 1900, 4½; 1899, 3½.

The Cork Electric Tramways and Lighting Company, Limited.—The receipts for the week ending Thursday, July 19th 1900, were £4?9 2s. 5d.; corresponding week last year, £501 6s. 3d.; decrease, £12 3s. 10d. Total to July 19th, 1900, £11,(88 14s. 2d.; corresponding period last year, £9,894 11s. 5d.; increase, £1,194 2s. 9d.

The Dover Corporation Tramways.—The receipts for the week ending July 21st, 1900, were £283 0s. 2½d.; July 22nd, 1899, £249 1s. 0d.; increase, £34 17s. 2½d. Total receipts to date, 1900, £5,292 17s. 11½d.; corresponding period 1899, £4,950 17s. 4d.; increase, £333 10s. 7½d. Miles of track open, 1900, 3; 1899, 3. Car miles run, 1900, 5,036; 1899, 4,510. Number of cars, 1900, 11; 1899, 11.

The Dublin United Tramways Company.—The receipts for the week ending Friday, July 20th, 1900, were as follows:—D. U. T. Co., horse cars, £33 4s. 11d.; ditto, electric cars, £3,937 10s. 9d.; D. S. D. Co., electric cars, £1,301 15s. 9d.; total, £5,272 10s. 11d; corresponding week last year—D. U. T. Co., horse cars, £2,247 5s. 9d.; ditto, electric cars, £1,3?6 3s. 3d.; D. S. D. Co., electric cars, £1,195 14s. 5d.; total, £4,779 3s. 5d.; increase, £493 7s. 6d.; aggregate to date, £14,299 12s. 7d.; aggregate to date last year, £12,810 5s. 6d.; increase to date, £1,489 7s. 1d. The mileage worked is 43 miles electrically, 1 mile by horses, as against 18 miles electrically, 26 miles by horses, for the corresponding period last year.

The Liverpool Overhead Railway Company.—The receipts for the week ending July 22nd, 1900, were £1,751; corresponding week last year, £1,610; increase, £141. Total traffics from July 1st, 1900, £5,193; ditto corresponding period 1899, £4,742; increase, £451. Miles open 6·57 chains.

STOCKS AND SHARES.

Wednesday Evening.

WITH the Bank rate raised, rumours of heavy new issues by the Governments of this country and India, to say nothing of the heat, the Stock Exchange is having a very uncomfortable time. Investment stocks are undergoing depreciation in every department, and only sellers make their voices heard in the land. But the actual volume of business transacted is in reality very small, and sage members of Capel Court are prophesying that no advance will come until business is brightened by the return of the Autumn, cooler weather and the holiday-makers. The Stock Exchange never quite loses its optimism, however black may be the momentary outlook.

The home railway market is passing through the throes of a severe slump consequent upon the wretched dividends so far declared, and the gloomy tone adopted by the various boards in issuing their reports. City and South London stock has been the worst sufferer so far as the electric lines are concerned, the price following up its drop of three points last week by a similar performance in the past six days. Business has been done at 58. Central Londons are 9¼—⅜ for the undivided shares. Again we would draw attention to the official folly of quoting them at a margin of 10s. between buying and selling; but the half shares are both better. Waterloo and City is nominally unaltered, but sellers of any amount of stock find some difficulty in disposing of it.

With other railway companies making so poor a showing, it is refreshing to find the Metropolitan directors saying almost pleasant things in their report. Reference is made to the electrifying of the line, but still the company seems to be in no great hurry to introduce the reform, how urgently needed only travellers on the Underground this week can testify. The District Railway's report has not yet appeared, but we hope that it will speak more unhesitatingly upon the subject of electrifying the line than does that of its brother-in-tunnels.

Great Northern and City "A" Preference, now with £7 a share paid up, are quoted 5—7, and the market is sleepier than ever.

Conspicuous as a feature of the telegraph department is the fall in Anglo-American Preferred stock, which was brought about by the action of a seller who was incautious enough to expose his hand in a weak market. He disposed of his stock, but at the expense of the quotation. The other issues of the Anglo-American Company are unaltered on the week, but they have not made up the pound lost at the time of the report's appearing. The Deferred stock seems unable to raise its head above 12, and the weakness of the "B" security naturally exercises a malignant effect over its junior stock. Great Northern of Copenhagen have been sold to a small extent and mark a loss of a point. The Far Eastern Companies' issues maintain their position with firmness, but Eastern Ordinary failed to respond to the cheerful tone of the meeting. The retirement of the Marquis of Tweeddale from the chairmanship of the Eastern and the Eastern Extension undertakings exercised no influence over the prices, as he retains his seat on the boards.

That issue of 4½ per cent. Debenture stock by the County of London and Brush Electric Lighting Company, whose advent we forecasted last week, is now appearing, the amount offered being £100,000. As we foretold, the issue price is 108, by no means a cheap figure when strict trust investments can be obtained to pay 3¼ per cent. The prospectus, curiously enough, does not state for what purpose the money is required. Doubtless in order to help the new issue, the company's existing 4½ per cent. Debenture stock has been put up a point. The new Charing Cross Preferences fail to command any premium, and there are sellers in the market at 6d. per share above the issue price with no buyers. Details of the scheme for raising £100,000 new capital by the Notting Hill Company are now published, and await confirmation at a meeting to be held on September 1st.

The City of London Electric has strengthened its board by the addition of Mr. J. B. Braithwaite and Mr. H. Leon, both members of the Stock Exchange, and both well versed in matters appertaining to the finance of electric lighting. Mr. Braithwaite, it will be remembered, was some years ago on the City of London's board, but dissociated himself from it on account of his disagreement with the policy pursued by his then colleagues. It will be more than ordinarily interesting to notice how the company will progress now that he has consented to help in extricating it from its present troubles.

St. James's and Pall Mall Ordinary are harder on the declaration of the 10 per cent. dividend, and Westminsters have also improved now that the new shares are fairly settled in firm hands. Metropolitans are easier, the old story of trouble with the Marylebone Vestry being on the carpet again, and Charing Cross Preference have also shed a fraction, it being feared that the new issue alluded to in the last paragraph may prove a fiasco.

National Telephones remain at 5. The latest emission is not yet officially quoted, although the special settlement has taken place. For the new shares the price is ⅛ under that of the old, and a seller of 500 shares came on the market a day or two ago, possibly on behalf of one of the underwriters.

Buenos Ayres and Belgrano "A" Preference remain at 5 and the "B" at 4¼. Anglo-Argentines at 4 are steady. A Foreign Office report issued on Tuesday says that a concession has recently been granted in Buenos Ayres to run a line of underground tramways by electricity between two ends of the city.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1897.	1898.	1899.	Closing Quotation July 18th.	Closing Quotation July 25th.	Business done during week ended July 25th, 1900. Highest.	Lowest.
110,900	African Direct Telegraph, 4 % Debs.	100	...	...	...	99 —103	99 —103	...	...
125,000	Amazon Telegraph 5 % Debs., Nos. 1 to 1,250 Red. ...	100	...	...	...	85 — 90	85 — 90	...	...
875,520	Anglo-American Telegraph	Stock	3 %	£3 9s.	73/6	59 — 62	59 — 62	...	...
3,062,240	Do. do. 6 % Pref.	Stock	6 %	6 %	6 %	113½—114½	112 —113	113	111¾
3,062,240	Do. do. Deferred	Stock	...	18s. %	£1 7s.	11⅞— 12¼	11⅞— 12¼	12	11⅝
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	3 %	...	2½— 3½	2½— 3½	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	...	165 —175	165 —175	160	...
1,563,078£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	101 —103	101 —103	102¼	101¼
16,000	Cuba Telegraph	10	7 %	8 %	7 %	6½— 7½	6½— 7½	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	...	15½— 16½	15½— 16½	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	...	...	9 — 10	9 — 10	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	100 —104 %	100 —104%	...	...
60,710£	Direct United States Cable	20	3¼%	3½%	3 %	11½— 12	11½— 12	...	...
111,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	99 —102	99 —102	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	148 —153	148 —153	151	150½
1,795,000	Do. 3½ % Pref. Stock	100	...	...	...	96 — 99 xd	96 — 99	98	96
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	...	...	111 —116	111 —116	112½	...
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	14¾— 15¼xd	14½— 15	15 1/16	14¾
6,700£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	...	...	... — ...	... — ...	...	...
26,600£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	...	...	... — ...	... — ...	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	...	...	112 —117	112 —117	...	...
300,000£	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	...	...	...	100 —103	100 —103	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...	...	100 —103%	100 —103%	...	...
180,227	Globe Telegraph and Trust	10	4½%	5⅛%	5¼%	11¼—11⅜	11¼— 11⅜	11½	...
180,042	Do. do. 6 % Pref.	10	6 %	6 %	...	15 — 15½	15 — 15½	15⅝	15
150,000	Great Northern Telegraph, of Copenhagen	10	10 %	12½%	...	32 — 34	31 —33	31⅝	...
84,300	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	98 —101	98 —101	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	52 — 56	52 — 56	...	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	...	...	105 —108	105 —108	107	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680 ...	1	...	...	...	¼— ½	¼— ½	...	...
86,492	Do. do. do. 5 % Pref., Nos. 1 to 86,492	1	4 %	4 %	2½%	¾— 1	¾— 1	...	...
490,000	National Telephone, 1 to 490,000	5	6 %	6 %	5 %	4⅞— 5⅛	4⅞— 5⅛	5 1/16	4 13/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 15	13 — 15	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	6 %	5 — 5¼	5 — 5¼	...	...
2,000,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	97 —100	97 —100	99	97
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅞— 1⅛	⅞— 1⅛	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	...	...	100 —103	100 —103	...	...
11,839	Reuter's	8	5 %	5 %	5 %	7½— 8½	7½— 8½	7 9/16	7¼
3,381	Submarine Cables Trust	Cert.	...	...	...	125 —130	125 —130	...	...
58,000	United River Plate Telephone	5	5 %	6 %	7 %	4¾— 5¼	4¾— 5¼	5 1/16	...
16,639	Do. do. 5 % Cum. pref. Nos. 1—16,639	5	...	...	...	5 — 5½	5 — 5½	...	...
179,947	Do. do. 5 % Debs.	Stock	...	...	...	104 —107	104 —107	...	...
200,000£	West African Telegraph, 5 % Debs....	100	...	...	...	97 —100	98 —101	99¾	99½
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	½— 1	½— 1	...	...
150,000	Do. do. 4 % Debs., 1—1,500 gua. by Braz. Sub. Tel.	100	...	...	...	99 —102	99 —102	...	...
389,731	Western and Brazilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	... — ...	102 —105	...	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	...	14¾—15¼ xd	14¾— 15¼	...	...
75,000	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	103 —106	103 —106	...	...
88,321	West India and Panama Telegraph	10	¾%	2 %	⅝%	⅝— ⅞	⅝— ⅞	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	...	...	6¼— 7½	6¼— 7½	...	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	...	...	6 — 7	6 — 7	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	...	...	102 —105	102 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	4 %	6 %	6 %	7 — 8	7 — 8	...	...
12,000	Do. do. 7 % Cum. Pref....	5	7 %	...	...	8½— 9½	8½— 9½	...	...
50,000	Charing Cross and Strand Electricity Supply	5	7 %	8 %	9 %	9½— 10½	9½— 10½	...	...
20,000	Do. do. do. do. 4½% Cum. Pref.	5	...	...	...	5½— 6	5½— 5¾	5½	...
34,000	*Chelsea Electricity Supply, Ord.	5	6 %	6 %	6 %	6½— 7½	6½— 7½	6¾	...
150,000	Do. do. do. % Deb. Stock Red. ...	Stock	4½%	...	...	107 —110	107 —110	...	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000...	10	10 %	6 %	4 %	8 — 9	8 — 9	...	...
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	...	12 — 13	12 — 13	...	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	...	...	122 —127	122 —127	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	*nil*	*nil*	4 %	8½— 9½	8½— 9½	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	...	11½— 12½	11½— 12½	...	...
200,000	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	...	107 —110	108 —111	109	...
26,100	Edmundson's Elec. Corp., Ord. Shares	5	5 %	7 %	...	4½— 5 xd	4½— 5	...	...
75,000	Do. do. 4½ % 1st Mort. Deb. Stock. ...	100	...	...	...	99 —102 xd	99 —102	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	1 — 1½	1 — 1½	...	...
49,840	Do. do. do. do. 6 % Pref.	5	...	6 %	...	4 — 4½	4 — 4½	...	...
250,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	98 —100	98 —100	...	...
85,000	Metropolitan Electric Supply, 101 to 62,500	10	6 %	5 %	5 %	14½— 15½	14 — 15	14½	...
220,000£	Do. 4½% First Mortgage Debenture Stock	...	4½%	...	...	111 —114	111 —114	...	...
220,000	Do. 3½% Mort. Deb. Stock Red.	Stock	...	...	...	96 — 98	96 — 98	...	...
6,452	Notting Hill Electric Lighting	10	6 %	6 %	7 %	15½— 16½	15½— 16½	...	...
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	13¾— 14½	14 — 15	14 9/16	14 9/16
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8½— 9½	8½— 9½	...	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	2 — 2½	2 — 2½	...	...
50,000	Do. do. 4 % Deb.	100	...	...	...	85 — 95	85 — 95	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	3¾— 4¼	3¾— 4¼	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000... ...	5	12 %	12 %	13 %	12 — 13	12½— 13½	13⅛	12⅞

* Subject to Founders Shares.
‡ Unless otherwise stated all shares are fully paid.
† Quotations on Liverpool Stock Exchange.
‖ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1897.	1898.	1899.	Closing Quotation July 18th.	Closing Quotation July 25th.	Business done week ended July 25th, 1900. Highest.	Lowest.
		‡							
65,000	Aluminium shares, Nos. 1—65,000	1	10 %	20 %	...	2¾— 3¼	2¾— 3¼	3 1/16	3
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	96 —101	96 —101	...	...
30,000	British Electric Traction	10	...	6 %	...	14 — 15	14 — 15	14 1/16	14½
50,000	Do. do. 6 % Cum. Pref.	10	...	...	...	12 — 13	12 — 13	12⅞	12⅝
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	123 —126	123 —126	125	...
85,000*l*	†British Electric Works Co., Ord. £1 shares, 50,001—135,000	...	...	...	...	⅜— ⅞	¾— ⅞	...	...
50,000	† Do do. 6 % Cum.Pref., 1—50,000 ...	...	...	...	...	1 3/16— 1 5/16	1 3/16— 1 5/16	...	...
500	† Do. do. 4¼ % 1st Mort. Deb.	100	...	...	...	97 — 99	97 — 99	...	...
40,000	British Insulated Wire Ord., Nos. 1 to 40,000	5	15 %	15 %	20 %	11 — 12	11½— 12½	...	...
27,500	Do. do. 6 % Cum. Pref. Nos. 1 to 27,000 ...	5	...	...	...	5⅝— 6 1/16xd	5⅝— 6¼	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	3 %	5 %	...	1⅝— 1⅞	1⅝— 1⅞	1⅝	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000 ...	2	6 %	6 %	...	2 — 2¼	2 — 2¼	2 1/16	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	109 —114	109 —114	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red	Stock	...	...	...	101 —103	101 —103	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	12½%	15 %	15 %	13 — 14	13 — 14	...	...
20,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5⅛— 5⅜	5⅛— 5⅜	...	...
90,000	Do. do. 4½ % 1st Mort. Deb. Stock Red ...	S ock	...	...	...	110 —114	110 —114	...	...
213,533	Central London Railway, Ord. Shares	10	...	...	...	9 — 9½	9 — 9½	9 7/16	9
61,038	Do. do. Pref. half-shares	5	...	...	...	4½— 4⅝	4½— 5	4⅝	...
71,447	Do. do. Def. do.	5	...	...	...	4¼— 4⅜	4½— 5	...	...
855,000	City and South London Railway	Stock	1⅞%	2⅛%	1⅞%	60 — 64	57 — 60	60	57
37,500	Do. do. Ord. shares Nos. 22,501 to 60,000	10	...	...	...	6 — 7	6 — 7	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	6 %	7½%	3⅜— 4¼	3⅜— 4¼	...	...
100,000	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red	...	...	...	...	99 —102	99 —102	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	6 %	6 %	2 — 2½	2 — 2½	2	...
17,139	Do. do. do. "A" Shares, 01—017,139 ...	5	6 %	6 %	6 %	3½— 4½	3½— 4½	...	...
344,023	Do. do. do. 4 % Deb. Stock Red ...	100	...	...	...	91 — 93	91 — 93	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6 %	2 — 2¼	2 — 2¼	...	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000... ...	2	7 %	7 %	...	3 — 3½	3 — 3½	...	...
140,300	Do. do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	103 —106	102 —105	...	...
9,600*l*	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600	10	7 %	7 %	7 %	10 — 11 xd	10 — 11	...	...
30,000	Henley's (W. T.) Telegraph Works, Ord.	5	12 %	14 %	15 %	13 — 14	13 — 14	...	...
30,000	Do. do. do. 4½ % Pref.	5	7 %	7 %	...	5¼— 5⅜	5¼— 5⅜	...	...
50,000	Do. do. do. 4½ % Mort. Deb. Stock...	Stock	4½ %	...	...	110 —114	110 —114	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	...	21 — 22	21 — 22	...	...
300,000	Do. do. do. 4 % 1st Mort. Deb	100	...	...	...	100 —103	101 —104	103½	...
37,500	†Liverpool Overhead Railway, Ord.	10	3½%	3½%	3⅜%	9¼— 9⅜	9¼— 9⅜	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	13¼— 13½	13 — 13½	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	35 — 39	35 — 39	37	...
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	101 —104	101 — 104	...	...
20,000	Telegraph Manufacturing, Ord. Nos. 1 to 20,000	5	...	8 %	12 %	10½— 11½	10 — 11	10½	...
20,000	Do. do. 5 % Cm. Prf. Nos. 1 to 20,000...	5	...	...	...	5½— 6	5½— 5⅝	5⅝	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	...	3 %	3 %	94 — 97	93 — 96	...	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

***Birmingham Electric Supply, Ordinary £5 (fully paid) 8—10.**
Brompton and Kensington, 4½ % Debentures of £100, 104—106.
National Electric Free Wiring, 12/6 paid. ⅛—¼.
Oldham, Ashton and Hyde Electric (£10 pd.), Ord., 17½—18½.
Do. do. Pref. (£10 pd.), 10—11.
*** From Birmingham Share List.**

Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12—13; 1st Preference Cumulative 6 %, £5 (fully paid), 7 —7⅛. Debentures, 102—104. Dividend, 1899, on Ordinary Shares 11 %.
***T. Parker, £10 (fully paid), 17½.**

Bank rate of discount 4 per cent. (July 19th, 1900).

MARKET QUOTATIONS, Wednesday, July 25th.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a ,, Nitric	per cwt.	22/-	22/-	..
a ,, Oxalic	per cwt.	32/-	32/-	..
a ,, Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	39/-	39/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33	£33	..
a ,, ,,	per ton	£30	£30	..
a Bleaching powder	per ton	£7	£7	..
a Bisulphide of Carbon ..	per ton	£15	£15	..
a Borax	per ton	£17	£17	..
a Bensole (90 %)	per gal.	7/-	7/-	..
a ,, (50/90%)..	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£25 10	£25 10	..
a Lead, Nitrate	per ton	£25	£25	..
a ,, White Sugar	per ton	£31	£31	..
a ,, Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	3½d.	3½d.	..
a ,, Caustic (75/80%) ..	per ton	£24	£24	..
a ,, Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	68/-	68/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6	£6	..
a ,, Recovered	per ton	£5 10	£5 10	..
a ,, Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	£10 15	..
a ,, Crystals	per ton	£3	£3	..
a ,, Bichromate, casks ..	per lb.	3¾d.	3¾d.	..

METALS, &c.				
Aluminium Wire, in ton lots..	per ton	£224	£224	..
b ,, Sheet, in ton lots	per ton	£191	£191	..
p Babbitt's metal ingots.. ..	per ton	£80 to 150	£80 to £150	..
c Brass (rolled metal 2' to 12') basis	per lb.	7¾d.	7¾d.	..
c ,, Tube (brazed)	per lb.	10d.	10d.	..
c ,, ,, (solid drawn) ..	per lb.	8¾d.	8¾d.	..
c ,, Wire, basis	per lb.	8¼d.	8¼d.	..
c Copper Tubes (brazed) ..	per lb.	11¼d.	11¼d.	..
c ,, ,, (solid drawn) ..	per lb.	11d.	11d.	..
g Copper Bars (best selected) ..	per ton	£83 10	£83	10s. inc.

METALS, &c. *(continued.)*		This week.	Last week.	Inc. or Dec.
g Copper Sheet	per ton	£83 10	£83	10s. inc.
g ,, Rod	per ton	£83 10	£83	10s. inc.
e ,, (Electrolytic) Bars ..	per ton	£82 10	£81	£1 10 inc.
c ,, ,, Sheets ..	per ton	£90	£90	..
c ,, ,, Rod ..	per ton	£84	£84	..
c ,, ,, H.C. Wire	per lb.	9¼d.	9¼d.	..
f Ebonite Rod	per lb.	3/-	3/-	..
f ,, Sheet	per lb.	5/-	5/-	..
n German Silver Wire	per lb.	1/6	1/6	..
h Gutta-percha fine	per lb.	..	8/- to 8/6	..
h India-rubber, Para fine	per lb.	3/10 to 4/-	3/10½ to 4/0½	½d. dec.
i Iron, Charcoal Sheets	per ton	£18	£18	..
i ,, Pig (Cleveland warrants) ..	per ton	69/6	68/6	1s. inc.
i ,, Forgings, according to size	per ton	From £11	From £11	..
i ,, Scrap, heavy	per ton	70/- to 72/6	70/- to 72/6	..
i ,, Wire, galvanised No. 8 ..	per ton	£18	£13 5	5s. dec.
g Lead, English Ingot	per ton	£18 to £18 5	£17 10 to £17 12 6	10s. to 12s. 6d. inc.
g ,, ,, Sheet	per ton	£18 15	£18 15	..
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bot.	£9 10	£9 10	..
d Mica (in original cases), small ..	per lb.	3d. to 9d.	3d. to 9d.	..
d ,, ,, ,, medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d ,, ,, ,, large ..	per lb.	3/3 to 7/3	3/3 to 7/3	..
p Phosphor Bronze, plain castings	per lb.	1/1 to 1/4	1/1 to 1/4	..
p ,, rolled bars & rods	per lb.	1/1 to 1/4	1/1 to 1/4	..
p ,, ,, strip & sheet	per lb.	From 1/3	From 1/3	..
o Platinum	per oz.	£3 13 6	£3 13 6	..
p Silicon Bronze Wire	per lb.	10½d. to 1/1	10½d. to 1/1	..
i Steel, Magnet, acc'd'ng to desc'p'n	per ton	From £15	to £40	..
i ,, ,, in bars		£58	£58	..
g Tin, block	per ton	£147 to £148	£146 to £147	£1 inc.
g ,, foil	per lb.	1/9	1/9	..
n ,, wire, Nos. 1 to 16	per lb.	1/9	1/9	..
p White Anti-friction Metals —				
"White Ant" brand	per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10 lb b'ndl's	per lb.	8½d.	8½d.	..
j ,, Best Flax, 6 lea.	per lb.	6d.	6d.	..
j ,, Hemp, 3 ply 10 lbs. ..	per lb.	4½d.	4½d.	..
j ,, ,, Russian, 10 lbs. ..	per lb.	5½d.	5½d.	..
j ,, Jute, 180 lbs. rove ..	per ton	£14	£14	..
k Zinc, Sh't. (Vielle Montagne ond.)	per ton	£24 5 nett.	£24 5 nett.	..

Quotations supplied by { *a* Messrs. G. Boor & Co. *b* The British Aluminium Co., Ltd. *c* Messrs. Thos. Bolton & Sons. *d* Messrs. F. Wiggins & Sons. *e* Messrs. Frederick Smith & Co.

Quotations supplied by { *f* India-Rubber, G.-P. and Teleg. Works *g* Messrs. James & Shakspeare. [Co., Ltd. *h* Messrs. Jackson & Till. *i* Messrs. Bolling & Lowe. *j* Messrs. Henry C. Yeo & Co.

Quotations supplied by { *k* Messrs. Morris Ashby, Limited. *m* Messrs. W. T. Glover & Co., Ltd. *n* Messrs. P. Ormiston & Sons. *o* Messrs. Johnson, Matthey & Co., Ltd. *p* The Phosphor Bronze Company, Ltd.

INSTITUTION OF ELECTRICAL ENGINEERS.

ALTERNATING CURRENT INDUCTION MOTORS.

By A. C. Eborall, Associate.

(*Paper read May 17th*, 1900.)

In the following paper some practical points connected with the construction, design, and performance of modern single and polyphase induction motors are first considered, and then follows a brief consideration of some recent developments in this branch of electrical engineering. The author originally intended to submit a short paper on starting devices for single-phase motors, but it afterwards occurred to him that it might prove of interest to bring up the whole question of alternating current induction motors for discussion, as the subject is of considerable interest to many, and has been somewhat neglected in this country up to the present.

On the other hand, some apology is needed for presenting such a paper to the Institution, because there is little that is really new in this branch of electro-technics.

PART I.

The Construction of Induction Motors.

(*a*) *Ironwork.*—The design of the ironwork, that is, of the stator and rotor cores, motor case, bearings, &c., is the same for all motors, single or polyphase, because a single-phase motor is practically a polyphase motor running on one phase.* The general design of all induction motors with regard to the case and bearings is fairly uniform with all makers. Up to 100 h.p., and for pressures not exceeding 1,000 volts, all standard motors are semi-enclosed, the stator core discs being built up inside a cast-iron case, and the bearings carried on open end shields. Thus the motors are virtually without bedplates. Bearings are always provided with ring or chain oilers, and the sleeves are of gun-metal for the small sizes and of Babbitt metal for the larger sizes. Shafts are frequently case-hardened in the neck and afterwards ground true.

For larger motors than 100 h.p., and for voltages above 1,000, a more open construction is employed, involving the use of a bedplate, to which the stator case and the pedestals are bolted. In this case the bearings are usually spherical. With large motors, great care has to be taken to keep the bearings absolutely rigid with regard to the stator case, on account of the relatively small air gap. For instance, for a 300-h.p. induction motor running at 200 revolutions per minute, at 40 cycles, the diameter of the rotor works out to be about 8 feet, and the air gap (iron to iron) would not exceed 0·2 inch. With such a motor it is absolutely necessary to stiffen the pedestals by means of arms radiating from them and bolted to the stator case.

Stator stampings are usually not less than 20 mils in thickness, and are built up with or without insulation between them. Ventilating ducts are usually provided in the core for all sizes above 30 h.p. Rotors are built up from stouter stampings, which need

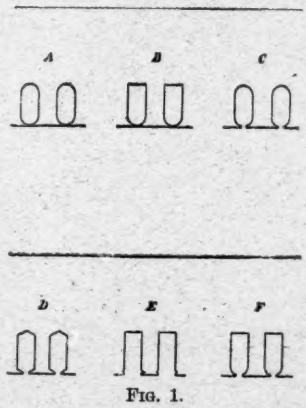


Fig. 1.

never be insulated; ventilating ducts in them need not be provided for motors less than 50 h.p., on account of the absence of iron loss in the cores of any appreciable amount.

The windings for both stator and rotor must always be iron-clad; that is, the cores must be provided with holes or slots. In fig. 1 are illustrated some typical forms of stator holes and slots.

The form marked A is the well-known Brown rectangular hole; that marked B is used by Messrs. Kolben & Co.; that marked C is the usual shape used in Germany; those marked D and E are American forms, while finally, the slot marked F is generally used in the motors built by the author's firm. The greatest winding space is given with square-topped slots—the bottom of a slot or hole is best kept rounded, as it produces a more even pole.

The arguments for and against the use of holes and slots are as follows:—With the employment of a hole-winding, the magnetising current of the motor is reduced to a minimum, because the inner periphery of the stator is smooth all round, and consequently the area of the air-gap is as large as possible. But if the small iron bridges at the bottom of the holes are more than mere shreds of metal, of the thickness of paper, there is considerable magnetic leakage across them, which may greatly affect the performance of the motor. In order to prevent this leakage, not only have the stator core discs to be tooled after being built up, that is, a cut has to be taken off the bore of the stator, but the interior of the holes has to be filed, and so the iron losses are unavoidably increased. A hole winding produces a somewhat smoother pole than a slot winding, but the former is much more difficult to wind, and the conductors are liable to get injured, owing to abrasion of the insulation while being pulled through, especially as the holes get nearly filled up with wires, and this injury may easily escape detection at the time.

The only real objection to partly closed slots is the increase of magnetising current produced by their use (it will generally increase 10—15 per cent.), but in the author's opinion this objection is far outweighed by the smaller iron loss and greater convenience attained with slot windings.

In many American motors the slots are quite straight, as shown, that is, their sides are parallel; this permits the use of former wound stator coils, which is an advantage, but on the other hand, the magnetising current of such motors is relatively very high.

A hole winding is open to another objection—unless a great many experimental data are available, it is impossible to calculate the motor in question accurately, as magnetic leakage cannot be estimated with any accuracy. On the other hand, the performance of a motor having open or partly closed slots can be accurately predetermined from the drawings, by means of suitable vector diagrams, such as those of Heyland* or Rothert.

With regard to the relative proportioning of stator and rotor holes or slots, the lengths of these should not, if possible, exceed $2\frac{1}{2}$ times the width, and the nearer they approximate to square or circular shape the better. This amounts to saying that the winding depth must be kept down, as otherwise the power factor and the overload capacity of the motor will be affected. The performance of a motor at starting, particularly if it has a permanently short-circuited rotor, and especially if single-phase, may be greatly improved by so designing the rotor that the slots or holes of the latter are not parallel to the holes or slots of the stator—for instance, they may be "staggered" by an amount not exceeding their pitch.

This constructional feature, first put forward by Mr. C. E. L. Brown about six years ago, is used with all the induction motors built by the author's firm, including the Heyland single-phase motors, as the results of many tests show it to be of considerable value.

The insulation of holes or slots is usually effected by means of

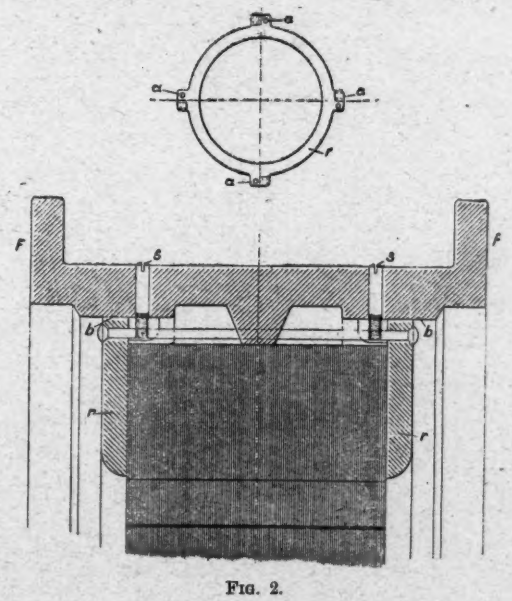


Fig. 2.

insulating tubes of compressed paper, fibre, veneer board, or micanite, the latter material being, of course, best, but not necessary for low tension motors.

The building up of the stator core in the motor case is an important feature of the design, and, moreover, the details connected

* While this is perfectly true, and although the general constructional lines are similar in each case, it must be borne in mind that far greater care has to be taken with the design of a single-phase motor than with that of a polyphaser if the best results are to be obtained. The bad effects of magnetic leakage are felt far more with the former than with the latter, and the performance of the motor is affected by apparently insignificant details of design. However, a very good polyphase motor will make a fairly good single-phase motor, as a general rule.

* Refer to "Polyphase Electric Currents" (Dr. Thompson), second edition, 1900; or to Mr. Heyland's latest publication, *Experimentellen Untersuchungen an Induktionsmotoren*, 1900 (published by F. Enke, Stuggart).

with it are frequently neglected. First, the stator core-discs should always be supported away from the case, and secondly, after having been assembled together, the stampings should not be tooled.* It is frequently difficult to avoid this after-tooling, more especially on account of the absolute necessity of having everything concentric, and therefore the author thinks it may be of interest to describe one method employed by his firm, as it has been found to give excellent results from all points of view; the method described is somewhat modified for large motors.

The stator core-discs are first stamped out of the sheet metal as exactly as possible (with modern American tools great accuracy can be attained), and then built up on an iron mandrel. After this, the end rings *r r* (fig. 2) are riveted on, the whole arrangement put in the lathe, and the four projections on the rings *a a* turned down to the right diameter, but left a trifle full. The case of the motor, already turned on the faces, *b b*, is now heated, and pushed over the core in this condition, so that after cooling, the shrinkage of the case holds the core tightly and securely. But to make everything absolutely certain, two or three screws, *s*, fix the case and the core positively. After the core is fixed in the case, the flanges on the latter, F F, are turned down, and must be, therefore, absolutely concentric and true with the stator bore, and true with the axis of the latter. Finally, the slots and end rings are heavily insulated, and the winding put in. The rotor cores are built up in the ordinary manner on the shaft, or on a spider, and are then put in the lathe, and the finest possible cut taken off them. In some cases even this cut is omitted, any slight irregularity or burr being removed by grinding.

The method of building the core into the case described and illustrated above will readily be seen to possess several advantages. These are, firstly, that owing to the core being supported away from the case, leakage through the latter is minimised, and consequently wasteful eddy currents and other detrimental effects are avoided, and moreover a free circulation of air can take place all round the core; secondly, the eddy current losses in the core and teeth are reduced to a minimum, and approximate very closely to the value

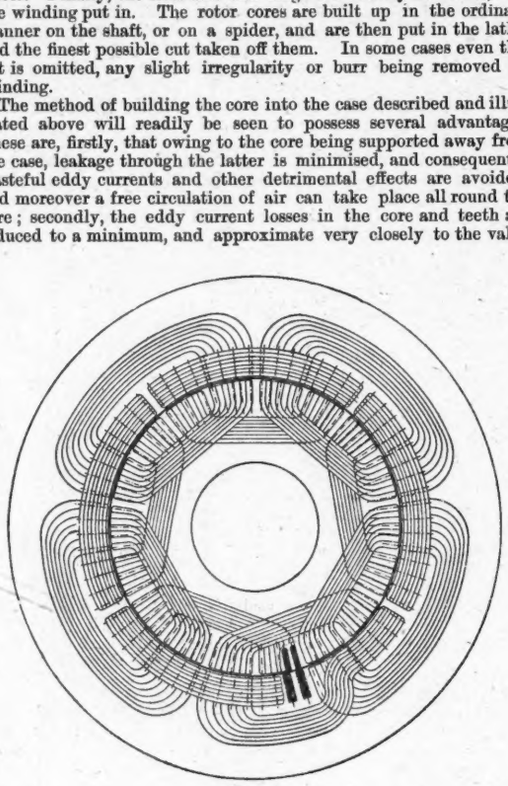


Fig. 3

obtained by calculation; and thirdly, as the core-discs are built up quite independently of the motor case, the width of core can be adjusted within certain limits to suit the output of the motor—a great advantage in practice, as it allows a given case to be used for motors of several sizes, and to a certain extent permits convenient variations to be made from standard designs.

It is usual with some constructors, notably with Mr. Kolben, to make the end rings or cheeks of the stator cores of brass or gun-metal. It is claimed that by doing this the leakage from pole to pole along the side flanks of the stator is sensibly diminished, or prevented altogether.

(*b*) *Windings.*—The stator and rotor windings of all modern induction motors are always of the drum type, these windings consisting in all cases either of simple rectangular coils, or regular bar windings, or modifications of the latter—for instance, the so-called squirrel-cage windings. A ring winding has three great disadvantages; firstly, it has an inherently large leakage coefficient, and secondly, its use necessitates the employment of a massive brass frame around the stator core (in order to minimise magnetic leakage) and it practically precludes the use of an external iron containing case for the stator, thus making the mechanical construction of the motor difficult and expensive; and thirdly, there is much idle wire.

As already stated, the stator coils of all motors are wound either in holes or slots, and for all usual sizes of motor these coils can be wire-wound with rectangular coils. With single and two-phase motors employing wire or cable-wound rectangular coils, there will be two ranges of coils, one range consisting of simple rectangular coils with straight ends, the other range consisting of precisely similar coils, but with bent ends. Thus each phase of the motor (with single phasers the starting coils, occupying not more than one-third of the total winding space, may be regarded as the second phase of the motor) will be made up of coils of definite shape, the coils of one phase being bent, at the ends, up and over the coils of the other phase, in order to clear them; from this arises the work-shop terms of the "straight phase" and the "bent phase," as applied to two-phase and single-phase motors. With the latter type of motor, the starting phase is invariably the bent phase, from motives of convenience in winding.

With two-phase and single-phase motors, it is usual to wind all the poles; that is, considering one phase only, the coils of this will be wound alternately right and left handed with regard to the direction of the current in them, that is, they will be cross-connected in the usual manner.

It is clear that for three-phase stators having rectangular coils, it would be a great practical advantage if they could also be arranged for two sets of coils, as with three sets the crossings of the phases at the ends are not only a source of danger (from the insulation point of view), but prevent damaged coils from being easily repaired.

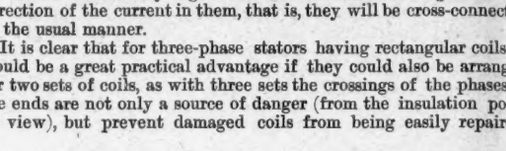


Fig. 4.

Moreover, if each set is in a different plane, there is no possibility of removing the rotor without removing the "bent down" coils, unless the stator core is built up in sections—a quite inadmissible construction. Consequently, for all three-phase stators for motors of standard sizes, and for all high tension motors, the coils of the various phases are always arranged in two sets, just as for two-phase motors, the coils of a given phase being alternately bent and straight. But in order to do this, and at the same time preserve the proper phase relation and pitch of the coils, an important modification of the winding has to be made, namely, only poles of the same signs are wound, in each phase. For instance, considering one phase only, there will be as many coils as there are *pairs of poles*, and all coils will be precisely similar with regard to the direction of winding and to the manner of connecting them up. This winding, which simply leaves each alternate pole unwound and doubles the number of turns on the wound poles, is obviously equivalent to the winding referred to above, both electrically and mechanically, but somewhat more copper is required with it, on account of the mean length of turn being greater.

It is worthy of note that with such three-phase windings for stators having an odd number of pairs of poles, the winding becomes slightly unsymmetrical at one point, where the end connections of the phases cross one another. This can be readily seen from an inspection of fig. 3, which shows a six-pole stator. Although for high-tension motors, and for very large low-tension motors, this may be an inconvenience, it is not found to present disadvantages in practice, for motors of standard sizes and voltages. As a general rule, too, the speeds of high tension motors can be so chosen that the number of pairs of poles required is even, while for

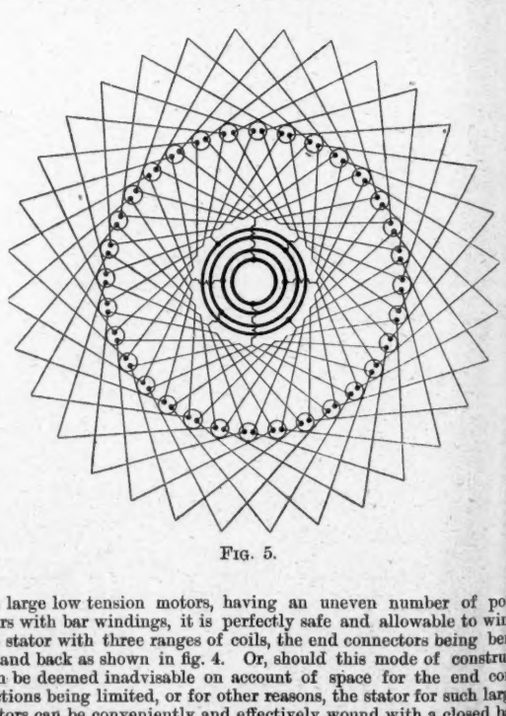


Fig. 5.

the large low tension motors, having an uneven number of pole pairs with bar windings, it is perfectly safe and allowable to wind the stator with three ranges of coils, the end connectors being bent up and back as shown in fig. 4. Or, should this mode of construction be deemed inadvisable on account of space for the end connections being limited, or for other reasons, the stator for such large motors can be conveniently and effectively wound with a closed bar winding. Such a bar winding, drawn out schematically for a two-phase motor, is shown in fig. 5, the four-pole case being taken for simplicity.

* See, however, previous remarks regarding hole-windings.

Standard three-phase stators wound with rectangular coils invariably have the coils connected star fashion. Stator bar windings for large low tension motors can be, and very frequently are, used with the mesh connection. Combinations of star and mesh are rarely or never found with modern three-phase motors.

The number of holes or slots per stator pole per phase has an important bearing upon the design of all induction motors. In order to keep the winding depth down, and to produce an even pole, this number is best made as high as possible—in practice it varies between four and eight. As is well known, with small motors, having squirrel cage rotor windings, the number of stator holes or slots should be preferably prime to the number of rotor holes or slots, the latter being, if possible, more numerous than the former, as this tends to prevent a cogging action taking place between the stator and rotor fields. The point is, however, of small importance when wound rotors are used.

Rotor windings for all induction motors are of two kinds, namely, permanently short-circuited rotors, and rotors having the ends of the windings brought to slip rings for the purpose of inserting a resistance into the winding at starting. The design and arrangement of these rotors is independent of the number of phases and of the stator voltage, a given rotor serving for a single, two, or three-phase motor, provided that, if slip rings are used, the number of stator poles is the same in each case, and that the flux per pole in the gap has the same value. There appears to be some difference of opinion as to how far the permanently short-circuited rotor can be used with satisfactory results—that is, at what output of motor it is best to bring in the starting resistance. For motors having to start against load (apart from crane, elevator, and mining motors), the author is decidedly of opinion that the squirrel cage construction, or its modifications, should be left behind with all polyphase motors above 5 B.H.P. With single-phase motors, which are usually arranged to start up light, wound rotors with slip-rings should be used after 7½ B.H.P. With the Heyland single-phase motors, referred to at ngth later on, a starting resistance in the rotor is used for all sizes. If the use of the permanently short-circuited rotor is pushed too far, the pressure regulation of the system, whatever the number of phases, is greatly impaired, owing to the excessive current consumption during the starting up of the motors. When it is considered that the best polyphase motors with squirrel-cage rotors, and starting under full load, require a momentary rush of current equal to at least two and a half times the full load current, this statement will be readily believed. It must not be forgotten in this connection, that under such circumstances, the power factor at the moment of starting will be low, with the result that the drop on the transformers, and perhaps even on the generators, is still further increased.

(To be continued.)

INSTITUTION OF ELECTRICAL ENGINEERS.

STUDENTS' SECTION.

SOME NOTES ON INQUIRIES FOR ENGINES.

By J. A. SEAGER, Student.

THE following are a few suggestions for guidance in inquiring for an engine, which will be found to obviate much unnecessary correspondence, and facilitate the delivery of a satisfactory steam unit. It is remarkable how many omissions can be made in a single inquiry—apparently due, not so much to carelessness, as to a misunderstanding of the requirements of the engine builder. It would add greatly to the quality of the work done, besides cheapening the price and reducing the time of completion of work, if the requirements of the customer could be made to agree more closely with the standard practice of the engineers.

The present notes are limited to main engines, such as those used for mill machinery, electric power plants, steamship propulsion, &c.

Horse-Power.—It seems almost unnecessary to say that the horse-power of the engine should be stated. The brake horse-power should preferably be specified. In arranging for belt—or rope—driving, as a percentage of power is lost in transmission, a 5 per cent. increase should be made to the calculated brake horse-power of the engine, for short, single drives—longer drives or multiple drives, of course, involving a greater percentage loss. It should be mentioned whether the driving is to be by rope pulley, belt pulley, or half-coupling for direct driving.

Steam Pressure.—I have seen a few inquiries for engines from which the boiler pressure has been omitted, although it is obvious that an engine cannot give the same power with low as with high pressure steam. If no boiler has as yet been installed, the engine makers should be asked to state the most suitable boiler pressure. If the boiler is already laid down, its working pressure, less the loss of pressure along the steam pipes (which may be from 5 lbs. in short, well-designed lengths, to as much as 15 lbs. in long or crooked arrangements) should be stated in the inquiry.

Speed.—The question of speed has an important influence, not only on the size of the engine, but often on the type also. For example, high speed engines (*i.e.*, from, say, 350 to 600 revolutions per minute) are now usually built vertical, and often with their cranks, connecting rods, valve motion, &c., enclosed. With slower speed, however, horizontal engines with large cylinders and unenclosed mechanisms are employed, or in situations where ground space is begrudged (as on shipboard and valuable ground), these open type engines are built vertically. It is not always possible to give the engine maker much latitude as to the speed at which he may run his engine, but wherever possible he should be allowed to select his own, or, at the very least, be given some slight range to choose from, in order that he may put in a standard, and therefore cheap, size which will run economically.

Condensing.—Although an economy can be effected by the use of a condenser, an engine should not be changed over from an atmospheric exhaust to a condenser without one is sure that it is mechanically strong enough to stand the strains due to increased difference of pressure on the faces of the piston, and the greater mechanical force transmitted at the same speed. For this reason the engine maker should always be informed whether a condenser is to be used or not. Two other reasons may be cited—the distributing valves would be set differently for the two conditions, and possibly a smaller engine could be put in if it were to run condensing. With large sized engines it is often advisable to have a separate condensing plant for each engine, the pumps for which could either be worked by the main engine or by small auxiliary engines. It is preferable, however to leave this point to the engine maker's discretion.

Description of Site, &c.—It would be disappointing if, after the engine was delivered, it were found to be too large in one of its dimensions for the space provided for it. The client should, therefore, either send a dimensioned sketch of his foundations, if supplied, or of the site, and also the height to roof, travelling crane or other obstruction, or he should ask the engine maker to send an outline drawing giving the main dimensions of the engine, when tendering. If the engine is to be erected inside a building, it would be well to make sure that there is a door or other convenient opening large enough to admit the engine when it arrives.

A description of the site should always be sent. For example, it is of interest to the engine maker to know whether his engine is to be placed on board ship, or on a concrete foundation, for in the latter case only will foundation bolts and plates be required. If the engine is to be erected by the engine people above or below ground level, this must be mentioned, as special lifting or lowering tackle will have to be provided. Details should be given as to the nature of the approach to the site—whether by land or water. In the former case it should be stated whether there is a road suitable for heavy traffic leading to the site; in the latter, whether there is a craneage wharf handy; and in both cases, whether there is a travelling crane or other suitable means for handling the engine on site.

Erection.—In the matter of erection, however, the client has the choice of three alternatives, (*a*) giving the engine maker the order to erect the plant complete on foundations to be supplied by the client if they are requisite, and giving the above information in full detail; (*b*) asking the engine maker to quote only for skilled labour in erecting, the client himself providing all rough labour, cartage, &c.; (*c*) the client undertaking to erect the engine on site himself, in which case he should ask for quotations f.o.r. or f.o.b. at the nearest railway station or dock. The first method is the most costly, but usually ensures good work. The last is perhaps cheap, and the result may be good or bad, according to circumstances.

It should be understood that only under exceptional circumstances, and by special arrangement, will engine makers allow in their price for building foundations for the engines, or for any masonry, builders' or joiners' work required, or for any excavating, cutting away, or making good again. If any such work is required, it must be definitely mentioned in the inquiry, and care should be taken to see that the engineer has bound himself to do the work.

Combined Plants.—For many purposes where small powers and high speeds are required, such as centrifugal pumps, fans, electric dynamos, &c., it is customary to supply a direct coupled set mounted on a common bedplate, thereby cheapening the cost of erection. In such cases the engine maker will supply the baseplate with his engine, and will, if requested, receive the apparatus to be fitted at his works, couple the same to his engine, and deliver the complete set ready for erection on the foundations. As a matter of fact, he will often undertake to supply the combined plant complete, fitting his engine to suit the needs of the fan or dynamo to be supplied, on receiving particulars of the work to be done by the plant. This method of ordering is recommended to non-expert purchasers, as it saves trouble for the client, and throws the onus of failure or defect entirely on the engine builder.

Tools, Accessories, and Spares.—A clause should be included in the inquiry calling for all necessary tools, accessories and spares. A firm of good reputation will put in a suitable set without further information, but, as a check, the following items (though not forming a complete list) should be looked for:—A complete set of spanners on rack—to be *kept* on rack except when being used on the engine—and any special tools required; spare springs and rings for pistons and (if needed) valves, set of main brasses and smaller brasses; eccentric strap and governor springs if required; barring gear, tachometer, steam pressure and (if running condensing) vacuum gauges, &c. Cans, tanks, and filters for oil are not usually supplied by engine makers.

It should be specially stated whether steam and exhaust stop valves are required with the engine, or whether they will be supplied with the pipe work. Engine makers cannot be expected to connect their engine to steam, exhaust, or drain pipes, unless this was arranged before signing the order, and if connecting pipes or bends have to be placed between engine and main pipes, the position of the flanges on the latter with relation to the engine should be indicated when asking for a tender.

Nature of Load.—Different types of engine, equally high class in workmanship, are designed with varying intent. Some are meant to withstand severe shock, such as is experienced in rolling mills; others, such as are used in cotton mills and electric generating stations, are required to give very uniform speeds under varying

loads; others again, where fuel and water are expensive, are designed to give extremely low water consumption and high efficiency; still others, destined to be placed in populous localities or on slight foundations, necessitate a careful balancing of moving weights to reduce vibration. If any such special conditions exist, they should be stated, so that the engineer may form an opinion as to whether heavy framework, Corliss valve gear, three-cranked shaft, &c., are applicable.

It should be carefully stated whether the direction of rotation of the engine is to be reversible or not, unless the particulars given of the work to be done imply one or other of these conditions as essential. If the engine is always to turn in one direction, it should be clearly stated which direction would be preferable, as "the engine to run clockwise (or counter-clockwise) as seen from the end of the crankshaft next the coupling or pulley."

Steam Consumption and Efficiency.—Where steam consumption and efficiency are important, makers should be asked to state a guaranteed value for these in their tender at, say, full and half load. These values should be tested when the engine is built, either at the engine maker's works or on site. In the former case, the client is at liberty to see the tests carried out, and verify the results himself, or he can have a signed certificate of tested results. In the former case, it almost goes without saying, the travelling expenses of the client are not included in the engine estimate, and it would be a breach of courtesy at least to claim from the engine maker any sums spent in this way. If the tests are conducted on site, all fuel and water required for the test should be supplied by the client. It should be noted that the efficiency of an engine when new is generally some 5 per cent. less than when it has been running a short time, as the piston rings and bearings have not then come to a proper bearing surface.

Speed Regulation.—A point respecting speed regulation should be explained for the benefit of those who require very good governing. It is customary to test the action of the governor by suddenly throwing the full load off the engine, and expressing the increase in speed at a percentage of the original speed. This percentage will be guaranteed by the builder if required, and in good engines will not be above 3 per cent. But it is an instant or two before the governors will "get hold" of the engine after the load goes off, and the speed flies up possibly over 10 per cent. above normal. This excess of speed, though lasting only a short time (at most 10 seconds with good governors) would be sufficient to burn out a high efficiency electric lamp if the engine were driving a dynamo, or break the threads in a spinning machine, if the engine were running a mill. For this reason, the percentage of instantaneous as well as permanent speed variation should be asked for if there is good reason for so doing.

Time of Delivery.—An engine builder cannot keep a stock of engines, except possibly in small sizes, so that a period must be allowed him to complete his order. Since time is money, the client should ask in his inquiry for a guaranteed time of completion of work, which will obviate any misunderstanding as to what constitutes a reasonable time of delivery, and will enable him to discriminate between a maker whose shops are already too full of work, and one who can supply the necessary power, labour and room to get the work through quickly. Such guarantees are, of course, given subject to delay due to strikes, lock-outs, accidents or other causes not under the control of the engine maker.

Although the above considerations by no means exhaust the points which have to be remembered in ordering an engine—it would be unfortunate for the consulting engineer if they did—yet, if those mentioned were attended to, the confusion of ideas which is apparent in many inquiries would be lessened, and the chances of getting a satisfactory engine much increased.

CURRENT SPECIFICATIONS.

XXII.—KINGSTON-UPON-HULL EXTENSIONS.

SUMMARY.

Extent of Contract.—Supply of four 90-KW. rotatory transformers, one variable ratio transformer of equal output, and additions to existing switchboards.

System in Use.—The present system in use is the high pressure direct current with a primary pressure of 2,200 volts, transformed through rotatory transformers placed at sub-stations to 450 and 225 volts for feeding the distributing network.

Specified Speed.—Not to exceed 500 revolutions per minute.

Bearings.—An alternative price to be given for fitting the transformers with roller bearings.

Automatic Switches.—For automatically cutting out the series coils on starting when the secondary E.M.F. is normal, to be supplied with each machine. Long range automatic switches for use in starting the machines suitable for being controlled from the generating station are also to be supplied with each machine

Permissible Temperature Rise.—Not to exceed 70° F. measured thermometrically after six hours' full load run.

Specified Dates of Completion.—Transformers—*six months* from date of order. Alterations and additions to switchboards—*three months* from date of order.

Penalty for Late Completion.—£1 per day.

Specified Terms of Payment.—50 per cent. on delivery on site, 40 per cent. on satisfactory completion, 10 per cent. at end of 12 months' period of maintenance.

Stipulations as to Removal of Foreman.—Satisfactory.

Stipulations as to Wages paid to Workmen.—Satisfactory, see comments below.

Arbitration.—None permissible, see notes below.

This specification has been drawn up by Mr. A. S. Barnard, the borough electrical engineer. There is really very limited competition in apparatus of this description, the switch gear is patented and must be obtained from one of two firms, while few manufacturers have developed standards for high tension direct current machines. If the wording of the specification is strictly adhered to as regards the construction of the transformers, the choice of machine left open to the engineer will be of the most limited character possible.

The switch gear and new switchboards specified are to be of a character comparable to those already in use.

The general conditions dealing with the engineer's power are of a very unsatisfactory character, they refuse arbitration and confer upon the engineer the sole right to interpret the meaning of the specification. Thus Clause 2 reads :—

The drawings and specification taken conjointly are intended to explain each other, and to be descriptive of the whole work comprised in the several contracts, and *all doubts as to the meaning of any portion of this specification or of the said drawings on the part of any person proposing to tender, must be settled before sending in his tender, between him and the engineer*, and *from the date of the execution of his contract, the contractor shall be finally bound by the engineer's decision, as specified in the twenty-fifth of these conditions*, and any details which are not sufficiently described by the drawings and specification shall be executed according to the engineer's directions, or according to any further detail drawings which he may provide. In the case of any discrepancy between the specification and drawings, or between the several drawings (if more than one), the specification shall be adhered to in preference to the drawings, and any drawing to a larger scale shall be adhered to in preference to any drawing on a smaller scale, and figured dimensions shall be adhered to in preference to dimensions measured by scale.

Clause 25, referred to above, states :—

The works generally and every part thereof shall be executed and completed to the satisfaction of the engineer, and *in all cases of difference of opinion as to the manner in which the work is executed, or as to the quality of the materials, or as to the true intent and meaning of this specification or the said drawings*, or *as to any matter of charge or account or otherwise*, as between the Corporation and the contractor, either during the progress or after the completion of the work, *the decision of the engineer shall be final and binding on both parties.*

We repeat our opinion that to thus confer upon one of the parties to any dispute the sole right of decision is *unfair* and *unjust*, and we urge all tenderers to resist these repeated claims by the servants of public authorities acting in a consulting capacity to impose upon manufacturers contracts from which arbitration clauses are intentionally omitted. The standard clause, reading as follows, agreed upon as satisfactory between the members of the Municipal Electrical Association and the Electrical Plant Manufacturers' Association, is the *minimum*, as regards arbitration, which should be allowed in electrical engineering contracts :—

In case any dispute or difference shall arise between the purchaser, or his engineer on his behalf, and the contractor, either during the progress of the works or after the determination, abandonment, or breach of the contract, as to the construction of the contract, or as to the reasonableness of any extra charge, or as to the withholding by the engineer of any certificate to which the contractor may claim to be entitled, then either party may within 72 hours, but not later, give to the other notice in writing of the existence of such dispute or difference, and such dispute or difference may be referred to arbitration, which arbitration shall be deemed to be a submission to arbitration within the meaning of the Arbitration Act, 1889.

A rather curious stipulation requires the contractor to obey verbal orders given by the engineer, and to ask in writing within a certain time for their confirmation, failure to do which, prevents him making any claim for extra work thus involved. The actual wording of this clause is :—

For any kind of work not specially mentioned in the detailed estimate, the price shall be fixed by agreement between the contractor and the engineer before the work is executed, or in the event of any such agreement not being come to, it shall be determined by the engineer only; but no claim for any extra work will be allowed unless upon vouchers in writing for the same, signed by the engineer. As, however, *the engineer or his representative may for some reason give verbal orders for the execution of extra work*, the contractor shall, unless he receives written confirmation of such verbal orders, give written notice of his intention to proceed with, or of his having commenced, the work referred to, *within one week* after such verbal orders are given, and *the non-delivery of such notice within the stated time shall be considered as an abandonment on the part of the contractor of any claim for the extra work.*

Piecework is expressly forbidden without the written consent of the Council, and standard rates of wages are to be paid. From the manner in which the labour clauses are drafted it would seem that there was an advanced labour party on the Council, as they seem to have been drawn up with a view to conciliate extreme trade unionists. Clause 12 states :—

> The contractor shall pay his workmen not less than the minimum standard rate of wages in the district for each class of labour respectively, and shall observe the recognised hours and conditions of labour generally, and shall forfeit to the Corporation the sum of £1 for each infringement of this clause, and a further sum of £1 for each day such infringement continues after his attention has been called to it.

And Clause 19 :—

> The contractor shall not assign or make over or under-let his contract, or any part thereof, to any other person, or make a sub-contract with any workman or workmen for the execution of any portion of the work (except for the supply of materials) without the consent in writing of the engineer, but he shall, unless with such consent, employ his own workmen, at daily wages ; and in case the contractor shall, without such consent, assign or make over his contract, or any part thereof, or sub-let or let at task work any portion of the work, he shall in each such case forfeit to the Corporation the sum of £100, which shall be deemed liquidated and assessed damages, and may be recovered by action at law, or deducted by the Corporation from any sum or sums due, or to become due, to the said contractor under this contract.

THE CLOSE SEASON.

[COMMUNICATED.]

Just about this time of the year we may expect to read in the technical journals that little Bungledom, or Great Pompousville, have decided with delightful unanimity, through the guardians of their local interests and affairs, assembled in more or less solemn conclave, to depute to a few citizens, for the time being members of the Lighting and Tramways Committee, the honourable task of journeying into the countries far and near which are tacked on to the edges of Bungledom or Pompousville as the case may be. Perils by land and by sea, perils by foreign languages, by foreign animals, and by foreigners' mixed drinks, will be cheerfully risked, nay, even courted by the heroic representatives of scores of towns besides Bungledom and Pompousville during the coming season ; not for selfish ends, not that the members of these deputations may feast their souls on the sights and scenery of foreign lands, not that they may, when they return, strut proudly before their fellow citizens as who should say, "We have seen the world," but simply and solely that they may benefit their respective townships and the world by studying, from as many aspects as possible, the application of electricity (subtle fluid) to the service of man. Noble men !

As a people, we have the reputation among other peoples for being self-satisfied, and if we consider just one detail in our economy—our local government—can we wonder that such a reputation has been attached to us ? No ! Our only wonder is that other people cannot see that our satisfaction is well grounded, that, from the single point of view referred to, we have as much right to be self-satisfied as, say, the people of the Swiss Republic.

Our Government, having too much to do with matters beyond the ken of mere outsiders, found that it was impossible for them to consider merely local matters ; so, having heard of the village Nestor, and thinking that after all there might be a remnant of wisdom left in the provinces after the London house had been supplied, they determined that the experiment of local government should be tried. Is it possible to imagine any of the members of that government looking on the result of their conception without feeling the pleasant pride of a father contemplating his offspring ? Let us, too, gaze with swelling hearts on this sublime manifestation of the progressive spirit of our age !

In any town of moderate size, modern civilisation demands many public works ; and, whereas in the bad old times private individuals would have undertaken schemes such as gas and electric lighting, waterworks and tramways, now no really progressive town would consider for a moment an idea involving private enterprise, unless a little harmless fun may be obtained at the expense of the selfish, money-seeking company, by a judicious course of dallying. (By carefully playing with your company you may easily bleed it of much gold ; not that the whole of it gets into your pockets, but, at least, it has gone out of the company's. Finally, of course, the company is told to run away, and the town itself carries out the scheme.)

Now that electric traction has been proved superior to any other, towns are beginning to combine their lighting and their traction schemes.* The same committee will, therefore, serve for both purposes ; and—at the risk of digressing—this throws into the best light the extraordinary adaptability of our councillors. Here is Mr. Jones, for example—Mr. Thomas Jones—who, from 9 a.m. till 5 p.m. on any week-day, may be seen lauding his silks and satins to citizenesses, who probably come as much to admire the versatile mercer as to buy his wares, for they know that, having thrown aside his yard stick, he will proceed to the Council chamber to criticise and demolish, or approve, the schemes brought forward by the engineers—consulting borough civil, or borough electrical. He, with his worthy colleagues, Mr. William Smith, the grocer, Mr. Richard Robinson, the retired fishmonger, and a few more equally important personages, are quite at home, whether debating the best means of sewage disposal, or the correct position of a tramway pole. These men are without doubt the most wonderful productions of a wonderful age ; to them no question but has its ready answer, no problem that cannot be resolved, one way or another, in the twinkling of an eye. (If a problem happens to be solved in a different manner, with bi-polar results, in two consecutive meetings, surely that is nothing to the discredit of anyone ; the lustre of absolute impartiality is but added to the halo of fame which surrounds each honoured head). Bungledom has settled finally that it is a rising town, that it is high time its street was lit by something other than oil, that walking is as out of date as oil-lighting, and that some form of mechanical traction is necessary. A Lighting and Tramway Committee is formed, and our friend Mr. Jones—Mr. Thomas Jones—is voted to the chair. As Mr. Jones says in his inaugural speech : "The committee is resolved to review the subjects on the 'tapis' *de novo*." (What a man among men he shows himself in every new phase of his life ! There are not many, Sirs, who could dexterously insinuate—modestly withal—that they had the mastery of two languages besides their own, and one of those a dead one.) "To that end they have left outside the chamber every predilection for—he may say all knowledge of—any particular system of lighting or of traction ; so complete is their desire for unbiassed judgment in all things."

But, having stripped themselves thus of every shred of knowledge concerning the things to be discussed, how, in the name of St. Joseph, are they to arrive at any decision at all ? One unacquainted with Mr. Jones would think this a poser indeed ! Not so, the chairman himself. He proposes to call in expert advice. . . . . Good ! but what of the expense ? Has Mr. Jones considered the number of experts to be fee'd if one is retained for every possible system of lighting and traction ? Yes, Mr. Jones has considered the point, and acknowledges that for a moment he was well-nigh "flummoxed" (Oh ! Mr. J., "flummoxed" after a dead language !) ; but, after deep thought, he now declares that one fee only need be paid if his advice be followed :—"Some eminent electrical engineer to be engaged as consulting engineer. He will be requested to report on all systems, and will, if necessary, be empowered to visit other towns, and even other countries, and—the council consenting—Mr. Jones would propose that a few members of the committee should be selected to accompany the engineer, to keep him from feeling lonely, and to be at hand to help him if he sees anything he does not fully understand."

Vociferous cheers greet this sparkling proposal, and the thing is practically done.

At the next meeting the chairman produces several letters

* This seems unrighteous, if we consider that that is best which compasses the greatest good for the greatest number. If schemes are combined in this fashion, we shall halve the number of our townspeople who see the world, unless we double the numbers in our deputations.

which he has received from as many eminent consulting engineers, who offer to do for Bungledom just what Bungledom had decided should be done last week. In fact, these eminent engineers appear to be almost indecently eager to act for Bungledom, as the majority dilate on their previous services in this work, and name the sums which they would accept as fees; sums which are, in one or two cases, so ridiculously small, that Mr. Jones, and the committee after him, cannot help thinking what fine fellows these electrical engineers are who work purely for the love of their profession, and the honour which it brings.

Finally, one of the finest of the batch is retained; the members of the deputation are selected by ballot, and an itinerary is planned, which embraces in a conscientiously comprehensive manner the whole of Great Britain and Ireland, including the Shetlands and the Isle of Man, so grandly do these brave hearts desire to do their duty.

This being the very point from which I purposed to start, it will surely make as good an ending place, which may be used for its original purpose if the long-suffering editors are willing.

OPPOSITION TO ELECTRICAL UNDERTAKINGS.

[FROM A LEGAL CORRESPONDENT.]

(*Concluded from page* 88.)

THE plainest cases of the right to *locus standi* are those in which the opponents of a proposed measure are themselves the proprietors of, or interested in, some undertaking of a similar character. Thus a gas company will naturally seek to oppose the establishment of an electric lighting plant for purposes of illumination within their districts. It appears that they are entitled to a *locus standi* in such cases, although the promoters allege (*a*) that the gas company has no monopoly of lighting; (*b*) that the principles applying to gas and electricity are quite distinct from each other, and (*c*) that a statutory gas company is not entitled to be heard against an electric lighting order. [See the Ferndale Gas Light and Coke and Waterworks Co., Limited, 1 S. & A., 314.]

Moreover, it seems that where the local authority of a district is seeking Parliamentary power to supply electricity, a statutory gas company, who also seek to supply electricity in the same district will be heard in opposition to the Bill. [See the Walker Order, 1899, 1 S. & A., 315.]

In the case to which we have just alluded, an objection to the proposed Bill was taken on behalf of manufacturers and others in the Urban District of Walker to the effect that as the local authority could not produce electrical energy profitably at a low price, and as the loss would fall upon them as ratepayers, they were entitled to oppose. The referees, however, refused to allow them *locus standi*, saying that the petitioners might, if they wished, be called as witnesses by the gas company, to whom a *locus standi* had already been granted. (*Ib.* 316.)

The earliest reported case relating to the opposition by a gas company to the promotion of a scheme for electric lighting is apparently that of the Hull Lighting Bill [11 C. and R. 251]. There the Corporation of the borough of Kingston-upon-Hull, who alleged that their local Act enabled them to provide for street lighting within the borough by means of gas, oil, "or otherwise," sought statutory powers to raise money for the purpose of public lighting by electricity. The Bill was opposed on the ground of competition by three gas companies which lighted different parts of the borough; and on their behalf it was urged that under the local Act, as under the Public Health Act, 1875, the Corporation could not do more than contract for a supply of the means of lighting, whether derived from gas, electricity, or other sources, and that a competition with private enterprise, carried on by the help of public rates, stood on a different footing from a competition between gas companies. It was decided that the petitioners were entitled to a general *locus standi* to come in and oppose the Bill.

In a second case, which was also decided in connection with the scheme of the Corporation of Kingston-upon-Hull, to promote a Bill for the supply of electric light within the borough, the Kingston-upon-Hull Dock Company and the North-Eastern Railway Company, who claimed the ownership of the soil in certain streets within the borough, and upon whom the duty of repairing those streets was imposed, claimed a general *locus standi* against a Bill promoted by the Corporation for public lighting by means of electric light. For the purposes of the Bill the Corporation would have power to take up the roadway in the streets. A limited *locus standi* was conceded to both petitioners for the protection of their interests. [See 2 C. & R., 254.]

With regard to electric railways involving the laying of wires, whether overhead or underground, in the streets, it has been decided that a gas company is entitled to *locus standi* to oppose any clauses in the Bill which affect their mains and pipes. Thus in the Kidderminster and Stourport Electric Tramways Bill [1896, 1 S. and A. 108], the petitioners were a gas company, and alleged that the Bill would authorise the promoters to interfere with the access to and the maintenance of their mains and pipes. They alleged that it would be impossible to work the tramway without a liability to explosions, which recent experience had shown might take place through "sparking." The promoters contended that the petitioners were sufficiently protected by the model clauses in the Bill; but in spite of this, it was held that they were entitled to *locus standi*.

In the Electric Lighting Provisional (Bermondsey and Marylebone) Orders (No. 12) Bill [1 S. & A. 249], the promoters, who were the local authority of the district, sought to confirm an order authorising them to supply electric light within their district. The petitioners were two electric lighting companies *outside* the district, who asked for a *locus* to raise the question whether, when there is a statutory company already carrying on its business, powers should be given to the local authority to enable it to enter into competition with the existing company. The promoters contended that the parties to be heard are the companies already supplying electric light within the district, but that the petitioners had no rights within the area, and were not entitled to be heard. It was decided that the *locus standi* of both petitioners must be disallowed.

Again, the mere fact that a particular company has a general interest in the disallowance of schemes for electrical supply does not entitle them to be heard in opposition to the Bill in Committee.

Thus in the case of the Bermondsey Order, 1899, [1 S. and A., 250], the petitioners [the County of London and Brush Provincial Electric Lighting Company, Limited], who had been refused an order to supply electricity in Bermondsey, but asked to be allowed to be heard on the ground that Parliament had, as shown by the Report of the Joint Committee, recognised that it was for the public advantage not to multiple generating stations in London, and they claimed to have such an interest in the general question as entitled them to be heard. The promoters contended that the proper party to be heard was the existing company who supplied the district and not the petitioners. It was decided that the *locus standi* must be disallowed.

One of the most important cases relating to the adoption of electricity as a means of traction was the Dublin United Tramways (Electrical Power) Bill [1897, 1 S. & A 157]. In that case the Bill authorises the use of electrical motive power on the tramways of the Dublin United Tramways Company, who had also another Bill before Parliament for the construction of further tramways. The petitioners, a railway company, alleged that provisions contained in a former Act were wholly omitted from this Bill, and that they would suffer by competition. In a former case the same petitioners had been refused a *locus standi* on similar allegations. The petitioners now contended that that decision should not be followed, on the ground that subsequent events had not proved that what was then considered to be merely an improvement of existing competition was in reality an entirely new form of competition. The promoters contended that the principal object of the Bill was to authorise the substitution of electrical for animal power on their tramways, and they pointed out that the Court had already decided that this was merely an improvement of existing

competition, and that the petitioners were not, therefore, entitled to be heard. It was decided that the probable competition in this case would be so small as not to warrant the Committee in giving a *locus standi*.

The following conclusion may be drawn from the foregoing cases:—Persons are entitled to a *locus standi* when (1) the object of the Bill is to construct works or authorise undertakings which will compete with those of the petitioners; (2) they are representative of the body of ratepayers who oppose the local authority in undertaking the work; (3) where they represent a gas company whose interests will be injuriously affected by an electric lighting installation, (*a*) either by open competition, (*b*) or by interference with their mains or pipes; (4) the proposed works will involve the uprooting of streets, the duty of repairing which is on the opponent.

On the other hand, a *locus standi* will not be granted in the following cases:—(1) Where the undertaking is one where the proposed opponents could not lawfully carry on; (2) Where their interest in the scheme is of a merely general nature; (3) Where the competition alleged is that between an electric tramway and a railway company, there having been in existence previously a horse tramway continuously competing with the railway.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS, 1900.

Compiled expressly for this journal by W. P. THOMPSON & Co. Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester and Birmingham, to whom all inquiries should be addressed.

12,388. "Improvements in or relating to mechanical motive devices for the controlling drums or switches of electrically propelled vehicles." A. J. BOULT. (E. R. Gill, United States.) Dated July 9th.

12,391. "Improvements in electric traction." G. P. HARDING. Dated July 9th.

12,392. "Improvements in clamps for holding the ends of electrical fuses o links acting as electrical conductors." CALLENDER'S CABLE AND CONSTRUCTION COMPANY, LIMITED, and J. C. A. WARD. Dated July 9th.

12,393. "An improved case or cover for electric switches, electric bell pushes, and the like." A. GROVES. Dated July 9th.

12,404. "Safety fender or life guard to attach to electric cars or other mechanically propelled vehicles." N. E. G. LITTLE. Dated July 10th.

12,434. "Improvements relating to the manufacture of conducting material for electrical and other purposes." H. H. LAKE. (W. J. Burke, H. A. Kaufhold, and T. Russell, United States.) Dated July 10th. (Complete.)

12,466. "Improvements in the construction of rail bonds for electric railways and in the mode of applying the same." G. G. M. HARDINGHAM. (Felten and Guilleaume, Carlswerk Actien Gesellschaft, Germany.) Dated July 10th.

12,469. "Improvements in vessels for containing fused salts during electrolysis." S. COWPER-COLES. Dated July 11th.

12,531. "Positive electrode for accumulators." C. VON SEDNEFF. Dated July 11th.

12,532. "Improvements in switches for accumulator electrodes." C. VON SEDNEFF. Dated July 11th.

12,537. "Improvements in and relating to accumulator plates." P. F. RIBBE. Dated July 11th. (Complete.)

12,554. "Appliance for generating electricity to be utilised for propelling machinery and for other useful purposes." W. SUNTER. Dated July 12th.

12,591. "Improved device for setting fuses or cut-outs in electric circuits.' C. C. T. SOHRMANN and C. M. O. FEIST. Dated July 12th.

12,598. "Improvements relating to driving axles for electric and other vehicles." C. CONTAL. (Date applied for under Patents, &c., Act, 1883, Sec. 103, January 6th, 1900, being date of application in France.) Dated July 12th.

12,603. "Improvements in or relating to shades for incandescent electric lamps." ENTWISTLE & STEPHENS, LIMITED, and H. J. STEPHENS. Dated July 12th.

12,609. "Improvements in testing sets for measuring insulation resistances." W. B. BURNIE. Dated July 12th.

12,634. "The Parsons automatic storage battery switch." E. M. PARSONS. Dated July 13th.

12,655. "Means for steering torpedoes and other crafts by intermittent light flashes," C. J. VARICAS. (This being a supplemental invention to Specification 27,128, and dated December 23rd, 1898, for an etheric steering apparatus.) Dated July 13th.

12,672. "Improved manufacture of glass by electrical heating and apparatus therefor." A. VOELKER. Dated July 13th. (Complete.)

12,673. "An improvement in the manufacture of glass by electrical heating." A. VOELKER. Dated July 13th. (Complete.)

12,702. "Improvements in accumulators." A. A. RIASSE and J. J. A. SENGEISEN. Dated July 13th. (Complete.)

12,709. "Improvements in electric arc lamps." F. M. LEWIS. Dated July 13th.

12,716 "Improvements in electric switches." W. B. DALE. Dated July 14th.

12,733. "Art of reducing attenuation of electrical waves and apparatus therefor." M. I. PUPIN. (Date applied for under Patents, &c., Act, 1883, Sec. 103, December 14th, 1899, being date of application in United States.) Dated July 14th. (Complete.)

12,735. "Improved electrical railway fog and danger signal apparatus." H. J. EVERATT. Dated July 14th.

12,737. "Improvements in and connected with keys or switches in lampholders." H. OPPENHEIMER. (Actiengesellschaft Mix & Genest, Germany.) Dated July 14th.

12,739. "An improved dynamo-brush." J. F. P. RINGSDORFF. Dated July 14th.

12,743. "An improved method of and apparatus for the local application of electrical treatment to the human body." H. BEHRENDT. Dated July 14th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. THOMPSON and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1898.

17,588. "Improvements in or relating to primary electric batteries." A. J. Boult. (V. Besson.) Dated August 15th, 1898. A positive electrode is made of a mixture of one or more metallic oxides with plumbago or other form of carbon, made into an agglomerate with a solution of a sulphate and compressed around a block of carbon. The electrode may be used in wet or dry batteries. 3 claims.

17,880. "Improvements in pushes and like contacts for electrical circuits." W. R. Lambert. Dated August 19th, 1898. In a push or the like the fixed contacts are mounted in a barrel, and the circuit is completed by a split hemispherical contact carried on a shank of the press button. The provisional specification states that a catch may be fitted for locking the switch in position. 8 claims.

17,881. "Improvements in telephone exchange instruments." F. A. Lundquist and J. Anderson. Dated August 19th, 1898. Relates to a system by which any subscriber can select and connect himself to another subscriber on the same system without the intervention of an exchange. The arrangements of the subscriber's station are shown and also those at the exchange. A contact arm is mounted on an axle having a wheel which gears with a smaller wheel. The wheel carries a cam-actuated contact rod for braking and making the mercury contact on each revolution, which corresponds to the motion of the arm between two of the points. The telephone lever is provided with an extension, and also actuates a lever controlling various contacts. The contact spring and the arm have bevelled turned ends so as to allow the levers to pass in one direction only. The calling subscriber selects the subscriber wanted by placing the arm on the stop corresponding to the units, and then, after taking the receiver off its hook, turning the arm back to the stop, and giving as many complete revolutions as the tens of the number of the subscriber wanted. At the exchange station selectors are arranged corresponding in number to the subscribers, and having as many contacts as there are subscribers. These contacts are connected by lines and their branches. Each subscriber is provided with an operating magnet and a resetting magnet, which controls a releasing device for allowing the arm to return to its normal position under the action of a coiled spring. The magnet is inserted with contact, and operates the ratchet wheel of the arm by means of a pawl on its armature. 29 claims.

17,883. "Improvements in arc lamps." F. Booker. Dated August 19th, 1898 Relates to arc lamps, in which the heavier upper carbon holder is hung by a cord or chain and the lower holder by a cord from the opposite sides of a pulley, attached to a brake disc on a shaft. Series and shunt solenoids tend to draw down cores on a lever, which is linked to a pin on one side of a second disc loose on the shaft. The second disc may be serrated, and is opposed to a rubber ring carried within a flange on the disc. The discs are pressed apart by an interposed spring surrounding the shaft. The second disc carries two projecting inclines, which bear against stationary rollers when this disc is turned by the action of the series coil; the second disc then bears against the first one and turns it so as to strike an arc. The rollers are carried by a horizontal piece, pivoted at its centre on a support. This piece may carry the inclines, and the second disc carry the rollers. A spring adjustable by a screw presses the shaft endways against the pressure of the second disc. 5 claims.

17,896. "The production of incandescent materials suitable for use in electric lighting." S. Pitt. (L. W. Gans.) Dated August 19th, 1898. Filaments are made by partly or entirely coating small rods or other pieces of porcelain, glass, or other heat-resisting material with organic compounds of osmium, rhodium, ruthenium, or iridium prepared in the same manner as those used in the decoration of porcelain as by heating oil of lavender with chlorides of gold or platinum. The coated rods are then baked, coherent metallic coverings being thus formed on them. Osmium coatings must be heated in a reducing atmosphere. The coatings may be strengthened by electro-deposition. They may be separated by partially dissolving the rods in hydro-fluoric acid, and then curved to the forms desired, coppered at the ends, mounted on metal or carbon supports by soldering or otherwise, and used as filaments in the air, or an indifferent gas, or in exhausted bulbs. Hydro-chloric acid may be used as the solvent, if the rods are of suitable glass. Preferably, however, the baked rods are again coated with similar resinous organic compounds of thorium, zirconium, magnesium, or like metals, and again fired, coatings of the oxides being thus produced. The provisional specification describes the production of a filament by coating a glass rod successively with silver and an organic compound of alumina before the application of the coatings described above; the silver is afterwards removed by nitric acid. 2 claims.

20,221. "Improvements in the means or method of signalling on electric tramways." J. Kay and A. H. Gibbings. Dated September 24th, 1898. Relates to electric tramways which are laid in alternate sections of single and double tracks, and more particularly to means for signalling the entrance or presence of a car on to a single section. Two wires connected to electric lamps at the ends of the single sections are arranged parallel to the corresponding outward and return-conducting cables, and a weighted or spring-controlled lever is pivoted on the collecting-trolley, so that it makes contact with one or other of the wires and completes the lamp circuits. 1 claim.

20,227. "Improvements in electric lampholders." A. Watson. Dated September 24th, 1898. Relates to holders for incandescent lamps. Connection is made between supply wires and the contact plates of capped lamps by short flexible conductors, the free ends of which are held against the contact plates by spring plungers or equivalent means. The invention is a modification of that described in Specification No. 27,492, A.D. 1896. In one form the springs and flexible conductors bear against plates which are held in separate recesses in an insulator by blocks provided with lateral binding screws below the insulators to hold the supply wires. The flexible conductors may, if desired, be held in direct contact with the supply wires. 1 claim.

20,259. "Improvements in or relating to electric railways on a road contact or like system." L. M. Aspinwall. Dated September 24th, 1898. (Date claimed under Patents, &c., Act, 1883, Sec. 103, February 25th being date of application in United States.) Relates to conductors and switches for electric railways and tramways on a road contact or like system with electro-magnetic switches. The switches are excited by a current from a battery and transformer on the vehicle, or by a shunt from the main current passing through a coil on the switch and then to earth through a high resistance. In one form the switch has only a single coil through which the main current passes when the plunger is lifted to complete the circuit from the feeder to the sectional conductors. In the other forms the coil is divided so that the path for the main current is shortened. In another form the exciting current flows through the lower coil and resistance thereby lifting the small switch which opens a path for the main current and so excites the switch sufficiently to lift the large switch. The high resistance coils are thereby short-circuited, and the main current from the feeder to the contacts flows only through the thick coil which holds up the switch until the collector has passed. Double contacts may be used on each side for the main current path; of these one set may be metallic and the other set consist of spring-supported carbon blocks, at which the circuit is finally broken when the plunger falls. Dash-pot arrangements may be added to prevent the switch from opening when the currents in the coils are reversed. 4 claims.

20,262. "Improvements in post and bars applicable for telephone and telegraph posts, railway sleepers, and the like." E. O. V. Hellstrom. Dated September 24th, 1898. Posts and bars for telegraph, &c., purposes and sleepers for railway lines are formed of beton strengthened by a metal skeleton. The metal skeleton consists of pipes or rods braced by plates having upturned edges interposed with the beton. One or more rods or tubes may be employed. 3 claims.

20,274. "Improvements in systems of controlling electrically propelled railway trains." F. E. Case. Dated September 24th, 1898. (Date claimed under Act, February 28th, 1898, being date of application in the United States.) Relates to means whereby any number of electric motors on cars, when coupled to form a train, can be controlled from a single point on the train. Each car is complete

in itself, with a motor and controller equipment, and master controllers are provided on the train in the different cars. When one of these is in action the others are locked in their off positions. Each master controller has three switches for power, reversing and braking respectively, and the motor controllers are similarly divided. Preferably, the motor currents are not used between the master and the motor controllers, and preferably also the motor controllers have separate contacts or switch blades for certain steps and controller cylinders for other steps in the series parallel-control, all being worked by electro-magnets. The general arrangement of the connections and the construction of the switches are shown in the specification. An additional source of power carried on the vehicles supplies current for working the motor controllers and the brakes. This current is obtained from a battery which is charged by a motor-generator worked from the main circuit, an automatic cut-out being interpolated. 75 claims.

20,275. "Improvements in controlling electric motors and electrically-propelled railway trains." E. Thomson. Dated September 24th, 1898. (Date claimed under Patents, &c., Act, 1883, Sec. 103, February 28th, 1898, being date of application in United States.) Relates to means whereby any number of electric motors or cars when coupled to form a train can be controlled from a single point on the train. Each car is complete in itself, with motor and controller equipment, and master controllers are provided on the train in the different cars to work the motor controllers by a shunt off the main current. The general arrangement of the connections and the construction of the switches are shown in the specification. 25 claims.

20,276. "Improvements in systems of train control for electrically propelled vehicles." W. B. Potter. Dated September 24th, 1898. (Date claimed under Act, February 28th, 1898, being date of application in United States.) Relates to means whereby any number of electro-motors on cars when coupled to form a train can be controlled from a single point on the train. Each car is complete in itself, with motor and controller equipment, and master controllers are provided on the train in the different cars. The motor controllers are worked from the pneumatic pressure brake pipes, but the valves which determine the admission to the operative parts are electrically controlled from any one of the master controllers. The general arrangement of the connection and the construction of the operating mechanism of the switches is described in the specification. 52 claims.

20,353. "An improved bell switch." H. J. F. Voigt and J. A. Haefiner. Dated September 26th, 1898. Relates to switches for secondary batteries. The contact strips are arranged on a cylindrical casing, and are clamped by insulated rings. They preferably pass through the base, or switchboard, for the attachment of the cell connections. On the rings slide or rotate rings each of which carries one or two contacts formed with a carbon or metal block pressed against the contacts by a spring. One of the rings may be connected to the lamp circuit, and the other to one pole of the generator. The contacts are connected through resistances to prevent short circuiting. 1 claim.

20,393. "Improvements in or connected with electrical motor transformers." A. B. Holmes. Dated September 27th, 1898. In order to prevent reversal of polarity in motor transformers at local stations, the field magnets of the generator have a compound winding, one in connection with the distributing system, and the other in series with the main supply circuit. 1 claim.

20,394. "Improvements connected with the controlling of electrical circuits." A. B. Holmes. Dated September 27th, 1898. Relates to a method of controlling a current by automatically inserting a resistance should the current become excessive. A solenoid is arranged in the circuit, its core being connected to a lever carrying the bridging contact of the mercury cups and suitably weighted. In case of excessive current the core is drawn down, breaking the main circuit, and throwing in a secondary circuit having a resistance and a solenoid. This solenoid serves to hold down the core so long as the current is excessive. On the circuit being restored to its normal condition, the weighted lever drops, completing the main circuit again. 4 claims.

20,440. "Improvements in alternating current measuring instruments." H. P. Davis and F. Conrad. Dated September 27th, 1898. (Date claimed under Act, May 7th, 1898, being date of application in United States.) Relates to current meters for alternating currents. A laminated electro-magnet is excited by current supplied to a coil. Closed circuit coils surround parts of its poles, the currents induced in them producing a shifting of the magnetic field in the air gap of the core and turning a conducting disc carried by a shaft in opposition to a spiral spring. The shaft carries a pointer over a graduated circular dial. The spring is attached to the shaft and to an adjustable slotted plate. The disc moves in the field of a permanent magnet to damp oscillations. The edge of the disc is spiral in form, so that as it turns it gradually leaves the field of the electro-magnet to enable a uniformly divided scale to be used. The disc is balanced by slotting and weighing it. When the instrument is used for measuring current strength, the coil is connected with the ends of a non-inductive resistance having a temperature resistance coefficient at least as high as that of the disc. For measurement of electromotive forces, the coil is connected in series with a non-inductive resistance with a low coefficient; a small closed circuit coil having a high coefficient surrounds one pole of the core to produce a demagnetizing effect which diminishes as the temperature of the coil rises. These devices compensate for the diminished conductivity of the disc when its temperature rises, and for changes of frequency. 5 claims.

20,448. "Improved means for supplying current to electrically propelled railway vehicles." G. W. Johnson. (S. Hutchins.) Dated September 27th, 1899. Relates to conductors and switches for electric railways and tramways on a road contact or like system with electro-magnetic switches and with alternating or direct currents. The conductor which supplies current to the road contacts through electro-magnetic switches as the vehicle passes, is fed with alternating current by a transformer, or direct currents may be used. The electro-magnets are wound with a thick wire coil and a thin wire coil, and their armatures connected to the feeder touch for contacts when lifted. The main portion of the current flows to the road contact through the thick wire coil from the first contact and the remainder flows through the second contact and the thin wire coil. The other contacts are connected respectively to the thin wire coils in the adjacent magnets so as to excite them when the circuit is completed by the shoes, but the connections to the rearward magnets may be omitted if the vehicle is only to run in one direction. A switch on the vehicle shunts the current through a resistance when the motors are cut out to hold up the switches. 6 claims.

20,486. "Improvement in insulators for telegraph wires and the like." J. Taylor and W. Taylor. Dated September 28th, 1898. Insulators are provided with two transverse slots and a vertical connecting slot, in which the main conductor or short parallel portion and a binding wire lie. The insulator is cut away with dovetailed grooves to allow of the insertion and removal of a locking slide. One or more such securing arrangements may be applied on one insulator, and various insulators and slides may be suitably coloured for distinction. The lower part of the insulator may be of ordinary shape, and has a rubber sleeve inside the inner shed. A loose metallic sleeve acts as a protector from breakage. 4 claims.

20,528. "Improvements in standard cells for small electric currents." Siemens Bros. & Co., Ltd., and E. F. A. Obach. Dated September 28th, 1898. Relates to standard cells for small electric currents, and consists in the use in the combination with the positive electrode of a layer of a depolarising-compound consisting of a mixture of a depolarising salt with carbon and with a percentage of the metal forming the electro-positive compound of the depolarising salt in a finely divided state. In a Clark's cell the compound would consist of a mixture of equal parts by weight of neutral mercurous sulphate (free from mercuric salt) and purified plumbago with a small quantity of powder gun tragacanth. This is made into a stiff past with a saturated solution of zinc sulphate, and then pure mercury in a fine state of division is uniformly distributed throughout the mass. The compound is packed into holes in the carbon electrode, and the latter is then surrounded with a layer of it which is held in place by calico or the like. The invention may be similarly applied to the Watson cell or to that form of De La Rue's cell in which zinc, potassium chloride, silver chloride, and silver are employed. 1 claim.

20,531. "Electro-magnetic mechanism for actuating engine valves." J. McLaren and H. McLaren. (E. W. Naylor.) Dated September 28th, 1898. Relates to electro-magnetic mechanism for actuating engine valves. A disc is preferably secured to the main shaft. Admission valves open outwardly under the action of the electro-magnets, and are provided with internal projections against which the piston may knock in case of accident. The exhaust valves open inwardly, and are worked by the electro-magnets. A portion of the disc is of insulating material, the peripheral plate and face plate being conducting. Under the control of the governor the movement of the hub effects a simultaneous and equal movement of the rolls connected by circuit wires with the electro-magnets. The rolls are connected with the starting. The switches put the battery in circuit for working, and the hand switch is for starting. The switches are those for use when the engine and dynamo are running. 13 claims.

20,632. "Improvements in or relating to electrically propelled vehicles." R. W. Blackwell. Dated September 29th, 1898. Relates to electrically propelled vehicles, and consists of an arrangement of storage batteries, resistances, motors, and a switch or controller for effecting propulsion at several different speeds, giving different degrees of brake force, and providing for backing the vehicle. The controller or switch consists of a non-conducting cylinder carrying contacts. 3 claims.

20,661. "Improvements in and connected with distribution, connection, or terminal boards for telephonic systems." M. Dyng and F. G. Bell. Dated September 30th, 1898. Relates to a multiple coupling board in which the conductors of multiple cables are connected by means of screws passing through insulating bars to metallic cross bars. 1 claim.

20,677. "Apparatus for starting electric motors." G. Bullock. Dated September 30th, 1898. Relates to switching apparatus for starting motors, the main line current being supplemented or substituted by a transformed down current, resistances being so arranged in the switch that when an electro-magnet becomes inefficient, the transformer is cut out of circuit and the motor is connected to the supply leads. 18 claims.

20,685. "An improved coupling for electrical communication apparatus between parts of railway trains." R. R. Harper and J. C. Garnham. Dated September 30th, 1898. Relates to an electric coupling for railway carriages for connecting up the passengers' communication or electric lighting circuits. Each member of the coupling consists of a spring bow provided with undulating or serrated prongs, and is suspended by the short cable from the line wire terminal at the end of the carriage. To connect the coupling the prongs are slid together, the undulations interlocking with each other. One member of the coupling may have three prongs, and the other only one, the latter member being inserted between the prongs of the former. 3 claims.

17,921. "Improved process or means for producing designs, devices, and the like upon material for reproduction in castings, or by the zinco-electro deposit or other known processes." J. Stephen. Dated August 19th, 1899. A design is indented on a thin sheet of copper, brass, or other ductile metal with a stylus, and is filled up by the use of the stylus or by rubbing either surface of the sheet. A wax or other cast may then be made from the sheet, and improved with a graver or otherwise, after which an electrotype or cast in fusible metal is made from it. The electrotype or cast, or the original sheet, may be backed by electrolytically deposited metal, or fusible metal, or cement, and used as a die or stamp for printing, embossing, or moulding paper or plastic or other materials. Or castings may be made from both surfaces of the original sheet, and used as dies for embossing metal, book covers, cardboard or like boxes, or paper, or impressing rubber, wood pulp, or mastic. White plaster casts from the plates may be photographed for the production of printing blocks. 2 claims.

17,974. "Improved appliances for cooling dynamo." Siemens Bros. & Co., Limited. (Siemens & Halske Aktien Gesellschaft.) Dated August 20th, 1898. Relates to dynamo-electric machines. Air is caused to pass in thin layers at high speed and with eddying motion in contact with the largest possible surface of the field magnets and armature. In one arrangement, the air is drawn through the machine by means of a fan contained in a casing formed by plates, and takes three courses—(1) between the magnets; (2) around the armature; and (3) through the armature. The spaces between the magnets are nearly filled by prismatic bodies so as to form narrow channels in which are disposed corrugated metal sheets. In the longitudinal passages through the armature, helically-twisted metal strips are inserted to give the air an eddying motion. A chamber may be formed at the end opposite to the fan, into which cool air may be conducted by means of pipes from the outside of the building or from an artificial cooler. In a similar manner, the air leaving the machine may be conducted to the outside of the building. 5 claims.

18,024. "Improvements in or relating to electric time alarms or call boards and the like." A. E. Drew. Dated August 22nd, 1898. Relates to apparatus of the type described in Specification No. 2,581, A.D. 1897, for sounding alarms in different rooms at specified times. The hour hand of a clock completes circuit when not broken elsewhere for a battery every quarter of an hour, the contacts round the clock dial being connected by wires to separate contacts on a switchboard. The contacts are sufficient to provide for the times, say, from 6 to 9 o'clock, and are connected directly to the clock contacts. A return wire leads back, through an electric bell in the room, to the battery. The time at which the bell rings is determined by adjustment of the arm to the required contact. For times between 9.15 and 5.45, separate rows of socket contacts are provided, connected with the clock contacts, into which plug switches may be inserted. The plugs are connected by wires with the contacts, to one of which the arm should be turned. All the corresponding contacts of each room are in electrical connection, so that the alarms may all be sounded at the same time if desired. 1 claim.

18,067. "An apparatus for automatically starting and stopping electromotors, pumping water into storage tanks without any personal attendance whatever." J. Harding and J. W. Milner. Dated August 23rd, 1898. Relates to an apparatus for automatically starting and stopping electric motors used for pumping water into storage tanks. In the storage tank are arranged three small tanks 1, 2 and 3, fitted with floats carrying rods which, by means of adjustable tappets, actuate the resistance switch and the switch for making and breaking the motor circuit. The tanks 1 and 3 communicate freely with the storage tank, while 2 communicates therewith by a small opening. When the storage tank is empty, the float in tank 1 brings the lever of the resistance switch into the starting position, and water is pumped into the tank 2 through the pipe. As the float rises, the switch is turned full on. When 2 is full it overflows into the storage tank, and the float now rises until when the tank is full it breaks the motor circuit. As the water level falls, the resistance switch is moved to the off position by the float, and the make-and-break switch is closed by the third float. The float then again moves the resistance switch into the starting position, and the cycle of operations is complete. 1 claim.

18,137. "Improvements in contact apparatus for electric railways with underground current feed and partial conductors." C. F. P. Standebach. Dated August 23rd, 1898. Relates to electric railways and tramways on a sectional conductor system with mechanically-operated switches. Blocks are connected to the sectional conductor and main, are bridged by contacts which are mounted on a revolving plate of insulating material, and are connected by a lead wire. This plate is turned by a pinion on its spindle engaging a rack which extends into the conduit and is there acted upon by an arm carried by the vehicle. Springs return the parts. The appliance is enclosed in a casing with a cover. A partition made tight at its upper edge by a washer, dips into a mercury seal carried by the spindle so as to keep moisture from the upper part containing the contacts. 3 claims.

18,165. "Improvements in or relating to electric signalling or indicating apparatus." A. J. Boult. (V. J. Busson and E. F. Busson.) Dated August 23rd, 1898. Relates to time alarm signalling apparatus for use in hotels, workshops, schools, barracks, hospitals, &c, and is also applicable for use in laboratories, or in burning ceramic ware, &c. The minute hand of the clock carries a cam, which completes, between the lever and a contact the circuit of an electro-magnet every quarter of an hour, &c. This magnet, when energised, acts through the armature and pawl to rotate an arm from one contact to the next of the 48 contacts on the switch. The contacts are connected to hooks, above each of which is a time mark corresponding to the particular contact. The hooks are adapted to receive numbered contact pieces, which are connected to the wires from the bells in the rooms of which the numbers correspond to those on the contact pieces. The aperture in each piece is made tapered, to ensure a better contact with the hooks. In use, the piece corresponding to the room in which the person is to be called, &c., is hung on the hook corresponding to the time at which he is to be called. At the desired time the arm touches the proper contact and so completes the circuit of the corresponding bell. 7 claims.